A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

NOVEMBER, 1936.

GENERAL PHYSICS.

ADSORPTION.

4926. Gibbs' Adsorption Theorem. E. A. Guggenheim. *J. Chem. Phys.* 4. *pp.* 689–695, *Oct.*, 1936.—After a criticism of previous attempts at proving the theorem in an elementary way, a proof is given which does not make use of free energy or thermodynamic potential. R. P.

4927. Adsorption at the Interface between Two Fluids. Part II. C. W. Gibby and C. C. Addison. *Chem. Soc., J. pp.* 1306–1313, *Sept.*, 1936.—Investigations previously described [see Abstract 1388 (1936)] are extended to include two additional types of interface: aqueous solution-air, and aqueous solution-liquid aliphatic hydrocarbon, and to a fifth dyestuff, Bordeaux-extra, which in very dilute solutions exists probably in the form of single ions, or nearly so. No adsorption of any of the five dyes at the air-water interface could be detected. The adsorption curves for Bordeaux-extra at all three liquid-liquid interfaces are similar to those of Congo red or methyl orange, but the influence of the nature of the adsorbent is the reverse of that found for these two, the maximum adsorption on paraffin being twice that on benzene, and three times that on chlorobenzene, agreeing with calculations from the Gibbs equation. Full results for various concentrations are tabulated and discussed, activity coefficients are calculated, and application of the gas laws to adsorbed layers is considered. N. M. B.

4928. Recombination of Atomic Hydrogen in the Adsorbed Layer. O. I. Leypunsky. *Acta Physicochimica*, 5. 2. *pp.* 271–298, 1936. *In German.*—The adsorption and recombination of H atoms in an adsorbed layer on Ni, Fe, Ca and Al-surfaces are investigated over a temperature range − 180°–0° C. The H was absorbed up to 8 monolayers (under the assumption that the adsorption takes place over the metallic atoms) which indicates a considerable surface relief that is greatest for Ni and smallest for Al. The quantity of H adsorbed at − 180° C. depends practically on the amount of the previously adsorbed H_2 and not on the surface activity. A hypothesis concerning the mechanism of the adatomic recombination is proposed, which proceeds owing to the activated surface diffusion and surface collisions taking place, and a quantitative expression for the recombination is derived. The latter formula is experimentally confirmed and deviations therefrom are ascribed to inhomogeneity. H. H. Ho.

4929. Sorption Processes on Diamond and Graphite. Part I. Reactions with Hydrogen. Part II. Reactions of Diamond with Oxygen, Carbon Dioxide and Carbon Monoxide. R. M. Barrer. *Chem. Soc., J. pp.* 1256–1268, *Sept.*, 1936.—Diamond chemisorbs hydrogen very vigorously at temperatures above 400° C., the sorption being more energetic than on graphite. The heat of sorption for diamond = 58 k.cal./mol., and for graphite = 45 k.cal./mol., and the forms of the energy of activation: percentage saturation curves are different in the two cases. The results can be explained by reference to the perfection of the crystals. Admission of O_2 renders diamond inert towards hydrogen up to 820°.

Sorption of oxygen by diamond is physical at − 78° and chemical from 0 to 144°, but no oxides are liberated. From 244°–370°, pure CO_2 is liberated by interaction between O_2 and uncovered diamond surface. At higher temperatures the oxide film decomposes into a mixture of carbon oxides. Various phenomena attending these processes are described and discussed, and the reduction of CO_2 is studied. It is suggested that two types of active centre exist, one due to material of variable C–C distance, and one to differences in accessibility of surface available for physical sorption, and of internal surfaces. C. B. A.

***4930. Low-Pressure Manostat and its Application to the Adsorption of Hydrogen and Deuterium on Copper. T. Soller, S. Goldwasser and R. A. Beebe.** *Am. Chem. Soc., J.* 58. *pp.* 1703–1706, *Sept.*, 1936.—A device is described for the control of gas pressures to ± 0·005 mm. and its applicability to the measurement of adsorption rates at low pressures is demonstrated. At 0° and 2·63 mm. the relative rates of adsorption of H_2 and D_2 on Cu bear the ratio 5·5 to 1; and the difference in activation energies of adsorption for the two isotopes on Cu at 0° is 0·75 k.cal. The temperature inversion in the ratio of adsorbabilities of H_2 and D_2 on Cu, which had been observed previously, has been confirmed using the new manostatic technique. AUTHORS.

***4931. Preparation of Metallic Adsorption Powders. F. Durau.** *Phys. Zeits.* 37. *pp.* 684–688, *Oct.* 1, 1936.—The author first discusses the effect of surface condition upon adsorption and the discrepancies between the results of different investigators due to the difficulty of reproducing adsorption surfaces [see also Abstract **4433** (1936)]. An apparatus is now described and illustrated by section diagrams for the preparation of standard adsorption powders, and special preparative details are given for the metals Pb, Sn, Z, Cd, Ni, Cu, and Ag. N_2 and the inert gases were employed as protecting media. H. H. Ho.

See also Abstract 5025.

ATOMIC AND MOLECULAR STRUCTURE.

4932. Structure of Atomic Nuclei. N. S. Japolsky. *Phil. Mag.* 22. *pp.* 537–581, *Oct.*, 1936.—The structures of the neutron ($_0n^1$) and the nuclei ($_1H^2$), ($_1H^3$) and ($_2He^3$) and the α-particle ($_2He^4$) are discussed on the basis of the author's theory of elementary particles [see Abstract **4694** (1935)], according to which the elementary particles are certain axially symmetrical systems of Maxwell electromagnetic waves *in vacuo* which were called electromagnetic whirls or simply 'Whirls'. The question of interaction between the so-called "contrapolarised" Whirls of equal size (like the electron and the positron, or magneto-electron) and between identical Whirls when they are situated coaxially, which was considered in the previous papers only in a general way, is discussed in detail. The transformation of energy and of mass, resulting from the interaction of elementary particles, is also discussed in greater detail. The holding forces and the kinetic and potential energies of the particles forming the nuclei are determined. The difference between the sum of masses of elementary particles forming the neutron and the discussed nuclei and their resultant masses is calculated on the basis of the above-mentioned theory of elementary particles. The result agrees very well with the latest experimental data. AUTHOR.

4933. Neutron-Neutron Forces in the H^3 Nucleus. R. D. Present. *Phys. Rev.* 50. *pp.* 635–642, *Oct.* 1, 1936.—The variational procedure developed by Hylleraas [see Abstract 2936 (1929)] in regard to the lower states of the He atom, already extended to the normal and excited states of H_2 [see Abstracts 1005 (1935), 1686 (1936)] is extended to the H^3 nuclear problem. The neutron-proton interaction is represented by $Be^{-2r/b}$, and the calculations are made for radii of interaction b of 1·0 and $2 \cdot 0 \times 10^{-13}$ cm., resulting in binding energies of H^3 of 11·0 and 9·5 mc^2 respectively; 11·5 mc^2 is deemed to be a very conservative upper limit for this energy. C. A. S.

4934. Dependence of Nuclear Forces on Velocity. J. A. Wheeler. *Phys. Rev.* 50. *pp.* 643–649, *Oct.* 1, 1936.—The most general specification of the interaction between two particles consistent with the conservation laws involves distance, relative velocity and angular momentum, whereas the Wignerian and Majorana potentials are dependent on distance alone. A simple form of the interaction between neutrons and protons of zero angular momentum dependent on velocity is shown to be suitable for treatment of the binding energies of light particles. This is one instance of a group of non-Wignerian potentials, all of which will account for the saturation effect in nuclear binding. Methods of distinguishing between such a force and the Majorana force are suggested. C. A. S.

4935. Artificial Radioactivity. A. I. Alichanian, A. I. Alichanow and B. S. Dželepow. *Phys. Zeits. d. Sowjetunion*, 10. 1. *pp.* 78–102, 1936. *In English.*—The β-spectra of ten radio-elements ($^{32}_{15}P$, $^{56}_{25}Mn$, BrI, II, and III, Radio-Rh, -Ag, -I, -Ir and -Au) were determined by magnetic analysis [see Abstract 1317 (1935)]. The upper limits (in 10^5 eV) are 19·5, 32, 20, 20·5, 8·5, 25, 27, 21, 22, and 11·5 respectively, all ± 1, save ± 2 for BrIII, Ir and Au. The results are discussed in relation to Fermi's and Konopinski and Uhlenbeck's theories [see Abstracts 1547 (1934)] and 3410 (1935)], and also show that Sargent's law connecting these limits with the radioactive constant does not apply to all radioactive substances; nor is the relation between the probability of disintegration and the atomic number consequent on Fermi's theory confirmed. Full details of the chemical separation of the radioactive P, Mn, Br, and I are given. C. A. S.

***4936. α-Activity of Ce and Cs Induced by Neutrons. E. Fünfer.** *Phys. Zeits.* 37. *pp.* 693–694, *Oct.* 1, 1936.—With a very sensitive apparatus, which is described, an attempt is made to detect in CeO_2 and in CsCl, α-activity induced by neutron bombardment. In contradiction to the theory of Döpel, no appreciable activity is found, although, however, the substances, especially CeO_2, are shown to have a considerable natural activity which has been attributed by other workers to impurities, but which is here shown to exist equally in the pure metal and in the oxide. G. O. B.

4937. Disintegration Experiments on the Separated Isotopes of Lithium. L. H. Rumbaugh and L. R. Hafstad. *Phys. Rev.* 50. *pp.* 681–689, *Oct.* 15, 1936.—Observations made with targets of 18 micrograms of Li^6 and 200 micrograms of Li^7 under proton and deuteron bombardment give the following results. (1) Two groups of protons with mean ranges of 25·4 cm. and 29·6 cm. air-equivalent are emitted by Li^6 under deuteron bombardment at 540 kV. No group of such range is found for Li^7 under similar conditions. (2) Neutrons are emitted by Li^6 under deuteron bombardment at 300 kV and above. (3) Short period β-ray activity is observed from Li^7 under deuteron bombardment at 500 kV and above with no observable activity from Li^6 under similar conditions.

(4) γ-rays are emitted by Li^7 under proton bombardment in the neighbourhood of 450 kV and of 1000 kV, with no observable γ-rays or neutrons emitted from Li^6 with protons of these energies. AUTHORS.

***4938. Transmutation of Li^7 by Deuterons. A. E. Kempton, B. C. Browne and R. Maasdorp.** *Roy. Soc., Proc.* 157*A. pp.* 372–385, *Nov.* 2, 1936.—The continuous distribution of α-particles formed in the transmutation $Li^7 + D^2 \rightarrow He^4 + He^4 + n^1$ is investigated in detail. Counters not previously used in h.v. research are described. The possibility of the formation of a He^5 nucleus is discussed, but the experimental evidence so far obtained on this point is negative. It is shown that the observed neutron energy distribution (Bonner and Brubaker) and the α-particle distribution are in qualitative agreement if the assumption is made that (1) occurs in two stages, an excited Be^8 nucleus being temporarily formed. AUTHORS.

4939. Angular Distributions of the Protons and Neutrons Emitted in Transmutations of Deuterium. A. E. Kempton, B. C. Browne and R. Maasdorp. *Roy. Soc., Proc.* 157*A. pp.* 386–399, *Nov.* 2, 1936.—The angular distribution of the protons and neutrons emitted in the transmutations $D^2 + D^2 \rightarrow T^3 + H^1$, and $D^2 + D^2 \rightarrow He^3 + n^1$, is investigated. For the coordinates in which the centre of gravity of the system is at rest it is found that the angular distributions are symmetrical about an angle of 90° to the direction of the incident particles, but that the intensity of emission at 0° is about 3/2 times that at 90°. Both distributions are relatively insensitive to the energy of the incident deuterons between 100 and 200 kV. AUTHORS.

4940. Spectroscopic Indentification and Manometric Measurement of Artificially Produced Helium. F. A. Paneth, E. Glückauf and H. Loleit. *Roy. Soc., Proc.* 157*A. pp.* 412–422, *Nov.* 2, 1936.—By a micro-method it is possible to collect, in a pure state, the He produced by neutron bombardment from B according to the following reaction: ${}_5B^{10} + {}_0n^1 \rightarrow {}_2He^4 + {}_3Li^7$. The neutrons from a radioactive source equivalent to the decay of only 140 mc. Rn gave sufficient He for a spectroscopic identification. With stronger radioactive sources, of the order of 2 curie Rn, enough He was obtained for its quantitative determination; the neutrons from 2·04 curie Rn, mixed with Be, produced during its decay $2{\cdot}4 \times 10^{-7}$ cc. He. From this figure it can be deduced that 1 mc. sec. of a Rn-Be source emits at least $6{\cdot}7 \times 10^3$ neutrons. AUTHORS.

4941. Distribution of Heavy Water Isotopes over the Earth. E. H. Riesenfeld and T. L. Chang. *Naturwiss.* 24. *pp.* 616–618, *Sept.* 25, 1936.—Of the 18 possible different types of water molecule resulting from the three H and three O isotopes, the molecules $H^1H^2O^{16}$ (HDO) and $H_2^1O^{18}$ are mainly responsible for the differences in density found to exist between various naturally occurring samples of water and pure $H_2^1O^{16}$. Results of density measurements of water from the sea, land, rain, snow, minerals, plants and animals are compared with one another, the differences between the various values affording an indication of the distribution of HDO and H_2O^{18} over the earth. It is shown that the distribution receives a satisfactory qualitative explanation on the hypothesis, supported by theory, that evaporation constitutes by far the most important process giving rise to a separation of the various isotopes. Evaporation causes an increase in the fractional content of HDO and H_2O^{18} in the evaporating as compared with the evaporated water. J. E. K.

4942. Mass Analysis of the Chemical Elements. A. J. Dempster. *Am. Phil. Soc., Proc.* 76. 4. *pp.* 491–497, 1936.—Further experiments complete the preliminary analysis of the isotopes in all the chemical elements [see Abstract 2823 (1936)]. New isotopes not previously reported are found in Ce and Ba. Exact comparisons show that the usually accepted atomic masses of U and Th are too high and should be 238·090 and 232·070. The masses of the Pb atoms into which these elements are transformed by radioactive disintegration are observed, and compared with the values calculated from the particles emitted during these radioactive transformations. Agreement is found only after the mass equivalent of the energy of these particles is allowed for. AUTHOR.

***4943. Double-Focusing Mass Spectrograph and Masses of N^{15} and O^{18}. J. Mattauch.** *Phys. Rev.* 50. *pp.* 617–623, *Oct.* 1, 1936.—After a short summary of the theory of double focusing a mass spectrograph which works as an " achromatic lens" for all masses is described in some detail. It is found to work according to the theoretical expectations. The differences of " packing fraction " (*i.e.*, $\Delta M/M \times 10^4$) of doublets containing the rare isotopes N^{15} and O^{18} are determined. It is found that for the doublet at mass number 15 ($C^{12}H_3{}^1 - N^{15}$) : $\Delta M/M \times 10^4 = 15 \cdot 8_6 \pm 0 \cdot 05$, $\Delta M = 0 \cdot 02382$ and for the 18-doublet ($O^{16}H_2{}^1 - O^{18}$) : $\Delta M/M \times 10^4 = 6 \cdot 9_8 \pm 0 \cdot 10$, $\Delta M = 0 \cdot 01257$. With Aston's masses of C^{12} and H^1 the isotopic weights referred to $O^{16} = 16$ are : $N^{15} = 15 \cdot 0040 \pm 0 \cdot 0008$ and $O^{18} = 18 \cdot 0037 \pm 0 \cdot 0007$. The measurement of N^{15} gives the rare chance to compare the energy release of a nuclear reaction, *viz.*, $N^{14} + H^2 = N^{15} + H^1$ with its value derived entirely by mass-spectrographic determinations. AUTHOR.

4944. Relative Abundance of Isotopes in Mn, Cb, Pd, Pt, Ir, Rh and Co. M. B. Sampson and W. Bleakney. *Phys. Rev.* 50. *pp.* 732–735, *Oct.* 15, 1936.—Using a new type of ion source, the abundances of the isotopes of Pd, Ir and Pt are measured and the atomic weights deduced from these values. The atomic weight of Ir is found to be quite different from the chemical value. The analysis of Mn and Cb confirms the simple nature of these elements to a higher degree than known before. Evidence for the existence of Rh^{101} present to one part in 1300 of Rh^{103} is obtained. Likewise Co^{57}, present to one part in 600 of Co^{59}, is found. AUTHORS.

4945. Scattering of Neutrons in Matter. Part I. L. S. Ornstein. *K. Akad. Amsterdam, Proc.* 39. 7. *pp.* 810–812, 1936.—The author discusses the statistics of the scattering of neutrons by an assemblage of protons or nuclei for the case where the velocity of the neutrons is large compared with that of the latter. Expressions for the probability and for the mean value of the energy are derived. The corrections necessary for heavy nuclei are indicated. G. O. B.

4946. Diffusion of Slow Neutrons. G. C. Wick. *Accad. Lincei, Atti*, 23. *pp.* 774–782, *May* 17, 1936.—A general mathematical analysis is applied to determine the fraction of slow neutrons transmitted, reflected and absorbed by a thin layer of paraffin wax, together with the angular distribution of the scattered neutrons. The results obtained are in satisfactory agreement with the experimental observations of Fermi and others. F. C. C.

4947. Energy and Intensity of Groups of Neutrons Emitted by Po-Be. G. Bernardini and D. Bocciarelli. *Accad. Lincei, Atti*, 24. *pp.* 59–64, *Aug.*, 1936.—Using an arrangement of counters already described [see Abstract 3300 (1936)] the emission by a Po-Be source of two groups of neutrons with energy maxima at about 4 × 10^6 eV and 7·5–8 × 10^6 eV is demonstrated. F. C. C.

4948. Absorption of Thermal Neutrons in Silver at Low Temperatures. V. Fomin, F. G. Houtermans, I. W. Kurtschatow, A. Leipunsky, L. W. Schubnikow and G. Shchepkin. *Phys. Zeits. d. Sowjetunion*, 10. 1. *pp.* 103–105, 1936. *In German.*—The authors have investigated the absorption of the C-group of neutrons in Ag with Ag as detector (long period, 2·3 min.) at different temperatures. Details of apparatus and technique are included. It is established by control experiments that C-neutrons are not appreciably absorbed at 20° K. in 0·6 mm. steel. The absorption curve for Ag is measured with liquid H_2 as external environment, with paraffin at the temperature of boiling N_2 and with water at room-temperature, the thickness being so chosen that saturation of the Bjerge-Westcott inner curve was attained. The curve for room-temperature shows good agreement with the results of Fermi's. It is concluded that either the energy distribution of the neutrons of the C-group for thermal energies is not afforded by the Maxwell law, or that the 1/v-law for the absorption of neutrons of the C-group has no validity with the long Ag period as indicator; the latter conclusion is favoured. H. H. Ho.

4949. Production and Absorption of Thermal Energy Neutrons. G. A. Fink. *Phys. Rev.* 50. *pp.* 738–747, *Oct.* 15, 1936.—From measurements of the number of neutrons reduced to thermal energies in successive cylindrical layers of water the rate of absorption of the thermal energy neutrons is calculated. Some slowing down was also observed in similar experiments with C, Al, Cu, Fe and SiO_2. The angular distribution of slow neutrons emerging from the surface of paraffin wax spheres was found to be more concentrated along the normal than a cosine law distribution. Measurement of the absorption of neutrons having slightly greater than thermal energy proved that Hg is nearly transparent while Rh and Ag showed less absorption than for thermal neutrons. Experiments with a neutron source cooled to liquid-air temperature show increased absorption for H, Li, B, Rh, Ag, I, Gd and Hg but practically no change for Cd. The construction and operation of mechanical velocity selectors for slow neutrons is discussed and results are given showing that the neutrons from the source used were in thermal equilibrium with it. F. C. C.

4950. Metallic Bond, According to the Combined Approximation Method. H. Hellmann and W. Kassatotschkin. *Acta Physicochimica*, 5. 1. *pp.* 23–44, 1936. *In German.*—The authors determine the constants of the free atoms Na, K, Rb, Cs, Mg^+ and Ca^+, by means of the combined approximation process, which, by utilising the Pauli principle, treats the reciprocal effect exerted between the valency electrons and atomic residues by assuming an additional potential calculated from the atomic-spectra. The calculation for Mg, based on the empirical data for Mg^+, confirms the validity of the assumptions made and their applicability to problems of the free atoms. Based on the constants now obtained, the metallic bond between the atoms is then investigated. On the assumption of approximately plane waves for the valency electrons in the lattice, the lattice-interval, heat of sublimation and compressibility are evaluated and found to be in useful agreement with experience. H. H. Ho.

4951. Structure of Cl_2O. R. Pohlman and H. J. Schumacher. *Zeits. f. Physik*, 102. 9–10. *pp.* 678–683, 1936.—A new interpretation of the spectrum of Cl_2O is given which is based on the measurements in the infra-red made by Bailey and Cassie [see Abstract 4935 (1933)]. From this it follows that the molecular acute-angle has the value 105°, and is essentially in better agreement with the value which Sutton and Brockway [see Abstract 1908 (1935)] obtained from electron interference. Further, a very simple connection is indicated between the spectrum of F_2O and Cl_2O. H. H. Ho.

4952. Energy and Polarity of Molecules. V. Rasumovskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 1. *pp.* 21-28, 1936. *In French.*—The author's electronic theory of valency, based on the closeness of approach of the valency electrons to the atoms and the length of their stay within the spheres of attraction of these atoms [see Abstracts 3406 and 3407 (1936)], is applied to explain the differences in behaviour of the linkages C : N, C : O and C : C; and of the molecules C_6H_6 and C_5H_5N, CH_3 and BH_3; C_2H_2 and C_2H_4; of the various radicals Ch_nX_{3-n} ($X = Ph$ or C_6H_4Ph, $n = 0$–3); of C_2Ph_4, octatetraene; mesitylene-formic and -acetic acids; methyl-butyl- and methyl-isopropyl-ketones; *o*-dimethyl-aniline and -benzaldehyde, etc. C. A. S.

4953. Variations of the Atomic Weights of Terrestrial Elements. V. I. Vernadski. *Comptes Rendus (Doklady) de l'Acad. des Sciences,* U.S.S.R. 3. 3. *pp.* 129–133, 1936. *In French.*—The problem of the variation of the atomic weights of elements is discussed in short historical outline, and the case of isotopes, radioactive elements, and the effect of geochemical changes and of the reactions of vital matter is considered. Evidence is given that the abundance ratio of isotopes varies slightly with the source of the elements concerned and under the influence of the above changes. N. M. B.

See also Abstracts 4976, 4990, 5003, 5078, 5079, 5080, 5081, 5082, 5135, 5136, 5141, 5142, 5150, 5151, 5178, 5179, 5181, 5203, 5208, 5253, 5254, 5280, 5309.

COLLOIDS.

4954. Influence of an Electric Field on the Intensity of Tyndall Light from Colloid Particles. H. Uerlings. *Phys. Zeits.* 37. *pp.* 655–657, *Sept.* 15, 1936.—When placed in an electric field, sols with non-spherical particles give enhanced Tyndall light if the directions of the field and the electric vector coincide and are perpendicular to the line of observation. If the field is perpendicular to the electric vector, the scattering intensity is diminished. The effect of the field on the orientations of the particles is photographed under the ultra-microscope. C. B. A.

4955. Structures and Forces in Colloidal Systems. H. Freundlich. *Roy. Inst., Proc.,* 29. 2. *pp.* 232–252, 1936.—The author gives an account of the history and structure of colloids generally and in particular defines the term " isothermal reversible sol-gel formation " as " thixotropy." The lecture then concerns itself with the structure and forces concerned in thixotropic materials, particularly grain size, and the distinction between thixotropy and coagulation, and its function as the counterpart of dilatancy. Plasticity like thixotropy is linked up with close packing. The author instances and illustrates his lecture with simple popular examples and finally draws attention to the application to biological phenomena, and discusses tactoidal formations. An excellent summary. S. G. B.

4956. Absorption Edges in the X-Ray Patterns of Native and Mercerised Cellulose. W. A. Sisson, G. L. Clark and E. A. Parker. *Am. Chem. Soc., J.* 58. *pp.* 1635–1638, *Sept.,* 1936.—Diffracted general radiation from the 002 and 101 planes in native and the 10$\bar{1}$ plane in mercerised cellulose produces, on the X-ray negative, well-defined Br and Ag absorption edges which are similar in appearance to diffraction lines. Criteria for distinguishing absorption edges from diffraction lines are discussed. Absorption edges correspond to some, but not all, of the large interferences or micellar dimensions for cellulose reported in the literature. No spacings larger than the cellulose unit cell were found. AUTHORS.

4957. Liesegang Rings in Non-Gel-Like Media. Part II. V. Gore. *Kolloid Zeits.* 76. *pp.* 330–333, *Sept.*, 1936.—The author in continuation of his earlier work [see Abstract 4464 (1936)] in order to eliminate complications, now uses for the peptising inner electrolytes for the well-washed precipitates of Al, Cr, Ca and Mg hydroxides and carbonates and for the subsequent coagulating outer electrolytes those which by double decomposition with each other give no kind of precipitation, *e.g.*, such pairs of electrolytes as $KI\text{-}K_2Cr_2O_7$, $KI\text{-}BaCl_2$, $BaCl_2\text{–}HgCl_2$, $BaCl_2\text{–}CoCl_2$. J. K.

4958. Classification of Emulsions. A. Rabinerson and L. Kremnev. *Acta Physicochimica*, 5. 1. *pp.* 105–110, 1936. *In German.*—Emulsions as regards their material composition are divisible into three groups: (A) oil in water, (B) water in oil, and (C) fluid metal in water or other fluid. They are also divisible into: (*a*) dilute, (*b*) concentrated, and (*c*) foam-like. Metallic emulsions (C) are stabilised in the same way as (A) and (B); apparent differences are discussed. Foams (*c*) do not represent a disperse system in the ordinary sense; their stability is solely due to that of the lamellar framework of the foam. [See Abstract 2698 (1934).] C. A. S.

See also Abstracts 4983, 4990, 5176, 5248.

CRYSTAL STRUCTURE AND PROPERTIES.

4959. Quantum-Mechanical Calculation of Lattice Energy of NaCl Crystals. R. Landshoff. *Zeits. f. Physik*, 102. 3–4. *pp.* 201–228, 1936.—A general theoretical expression is derived from quantum mechanics for the lattice energy of alkali-halogen crystals. This is applied to the particular case of the NaCl lattice. The following numerical results are given. Lattice parameter $a = 5\cdot55$ L_h ($1\ L_h = h^2/me^2 = 0\cdot532$ Å), compressibility $\beta = 8\cdot2 \times 10^{-12}$ bar, lattice energy $E = 165$ k.cal./mol. J. I.

4960. Electronic Energy Bands in Sodium Chloride. W. Shockley. *Phys. Rev.* 50. *pp.* 754–759, *Oct.* 15, 1936.—The Wigner and Seitz method of cellular potentials is applied to the calculation of wave functions in NaCl. A renormalised Hartree field is used around the Cl and the Prokofjew field around the Na. The relative heights of the potentials are determined by use of Madelung's number. The problem of joining the functions at the cell boundaries is treated by the Slater method of fitting ψ and ψ' at midpoints. For the outer Cl electrons a reasonable approximation is to join at Cl — Cl midpoints only. This gives rise to a face-centred lattice for which solutions of the Slater conditions have been found by Krutter. Several new solutions are derived which allow fairly accurate energy contours in momentum space to be drawn for the Cl $3p$ band. If the joining is made at Cl–Na midpoints alone, a large number of unsatisfactory zero-width bands arise. When both Cl–Cl and Cl–Na midpoints are used, the boundary conditions can be treated only for special cases. For these they are consistent with the Cl–Cl solutions. Several attempts to calculate the u.v. absorption frequency are described and the difficulties involved are discussed. AUTHOR.

4961. Electronic Constitution of Crystals; LiF and LiH. D. H. Ewing and F. Seitz. *Phys. Rev.* 50. *pp.* 760–777, *Oct.* 15, 1936.—A self-consistent solution of the Hartree-Fock system of equations for the ionic crystals LiF and LiH is attempted using approximation methods previously employed in metals. The boundary equations which the periodic functions must satisfy in the case of a face-centred cubic lattice are examined from the group theoretical standpoint. The Hartree system of equations is solved using ion core fields which include the $(1s)^2$ electrons in both Li and F, so that 8 electrons are given periodic functions in LiF and two in LiH. These solutions, which are regarded as preliminary, involve the use of the "*s* sphere approximation." The final results in both cases show that the Hartree approximation allows considerable charge to be in the vicinity of the metal ion so that the classical ion model is appreciably incorrect in that the valence electrons are not localised in a definite region about the electronegative atoms. The extent to which this affects the Born-Madelung lattice energy computations is discussed from the viewpoint of a complete solution. AUTHORS.

4962. Structure of Thin Metal Sheets. R. Riedmiller. *Zeits. f. Physik*, 102. 5–6. *pp.* 408–416, 1936.—The structure of films of Ni, Au and Ag, 100 to 1000 Å thick, was examined by electron diffraction. The lattice constants were found to be 1·2 %, 0·8 % and 1 % greater than their values for the three metals in bulk. Admission of air results in the lattice constant of Ni increasing from 1·4 % to 2·4 % as oxidation proceeds. Introduction of H_2 to a Ni sheet increases the lattice constant by 1·8 %. The length of the metal crystallite was estimated to be 20 Å. F. C. C.

4963. Structure of Polonium by Electron Diffraction. M. A. Rollier. S. B. Hendricks and L. R. Maxwell. *J. Chem. Phys.* 4. *pp.* 648–652. *Oct.*, 1936.—Electron diffraction photographs ($\lambda = 0\cdot062$Å) were obtained from about 10^{-7} gm. of Po that had been volatilised in a stream of H_2 and condensed over an area of about 3 mm.^{2} on a thin collodion film. Diffraction patterns were also obtained from Bi and Te since it was expected that Po would have a similar crystal structure. Analysis of these patterns shows that the structure of Po closely resembles that of Te, the lattice being pseudohexagonal with $a = 4\cdot25$, $c = 7\cdot06$, or 14·12 Å, and the calculated density 9·39 assuming 3 Po in the pseudo unit of structure. The true lattice is probably monoclinic with $a = 7\cdot42$, $b = 4\cdot29$, $c = 14\cdot10$ Å and β quite close to 90°, a suggested value being $\beta = 92°$; the calculated density for 12 Po in the unit of structure is 9·24. A structure, based upon the space group $C_2^3 - C2$, in which each Po atom has four nearest neighbours, gives moderate agreement between observed and calculated intensities of reflection. AUTHORS.

4964. Lattice Constants of NaCl and of Rock-Salt. M. Straumanis and A. Ieviņš. *Zeits. f. Physik*, 102. 5–6. *pp.* 353–359, 1936.—By means of an absolute method, a modification of that of Debye-Scherrer, the lattice constant *a* of the purest NaCl at 18° C. has been newly determined as being $5\cdot6273_7 \pm 0\cdot0000_2$ Å. The accuracy is the highest yet attained and is due to the simplicity and certainty of the method. The lattice constant of natural rock-salt was found to be $5\cdot6276_8 \pm 0\cdot0000_5$ Å, instead of 5·26800 obtained by Siegbahn: a difference of 0·00032 Å or

0·0057 %. This constant was fully established by measurements on three rock-salt crystals from places of origin very far apart. It may be assumed that all large rock-salt crystals have practically the same lattice constant. From photographs at different temperatures the coefficient of expansion of NaCl is determined as $40 \cdot 5 \times 10^{-6}$. The precision of this powder method approximates to that of the X-ray spectroscopic method.
J. J. S.

4965. Chemical Composition of Pollucite. H. Strunz. *Zeits. f. Krist.* 95. *pp.* 1–8, *Oct.*, 1936.—This mineral is related to the zeolites, having the composition $[Si_4Al_2O_{12}]\ Cs_2$, H_2O, and the basis cell of the crystal contains two molecules of this compound. The lattice constant $a_w = 13 \cdot 71$ Å, and the probable space-group is $O_h^{10} - Ia3d$. F. I. G. R.

4966. Structure of Vanadium Pentoxide. J. A. A. Ketelaar. *Zeits. f. Krist.* 95. *pp.* 9–27, *Oct.*, 1936.—Powder and rotation photographs give $a = 11 \cdot 48 \pm 0 \cdot 01$; $b = 4 \cdot 36 \pm 0 \cdot 005$; $c = 355 \pm 0 \cdot 005$ Å; $a : b : c = 1 : 0 \cdot 380 : 0 \cdot 310$. There are 2 molecules in the unit cell, the molecular volume is 53·9, and the X-ray density 3·37. Birefringence positive. F. I. G. R.

4967. Manifold Polymorphic Transformations in Potassium Nitrate. W. Borchert. *Zeits. f. Krist.* 95. *pp.* 28–53, *Oct.*, 1936.—Two modifications exist in the range considered, the rhombic low-temperature form (aragonite type), and a high-temperature form (calcite type). Transformation temperature (on a rising scale) is 128° C. F. I. G. R.

4968. Structure of Silver Diammino - tetranitro - cobaltiate. A. F. Wells. *Zeits. f. Krist.* 95. *pp.* 74–82, *Oct.*, 1936. *In English.*—The crystal structure of $Ag[Co(NH_3)_2(NO_2)_4]$ has been determined. The crystals are tetragonal, $a = 6 \cdot 97$, $c = 10 \cdot 43$ Å, and the space group is $P4/nnc$ (D_{4h}^4). There are 2 molecules in the unit cell. From the space group it follows that the NH_3 groups in the complex ion are in the trans positions, whereas chemical evidence assigns the cis configuration to this ion. The structure is essentially a distorted face-centred cubic packing of the complex ions with the silver ions in the interstices. The corresponding ammonium and thallous salts are orthorhombic (digonal holoaxial) with space group $P2_12_12_1$ (V_4) and 4 molecules in the unit cell.
AUTHOR.

4969. Symmetry and Structure of the Minerals of the Arsenopyrite Group. M. J. Buerger. *Zeits. f. Krist.* 95. *pp.* 83–113, *Oct.*, 1936. *In English.*—The author describes an extensive investigation of the structure of arsenopyrite and the group of minerals of similar structure. After discussing the results already published, the author gives new data on the structure of three examples of this type of structure. These results which indicate the space groups C_{mmm}, C_{mm} or C_{222} differ from those formerly published. It is shown that the arsenopyrite structure can be derived by considering it as a superstructure based on the marcasite type. The details of the final structure are given in a table which includes values for "Ideal" arsenopyrite (monoclinic holohedral) and "common" arsenopyrite (triclinic holohedral). J. I.

4970. Structure of Mg_2Zn_{11} and $Mg_3Cu_7Al_{10}$. F. Laves and S. Werner. *Zeits. f. Krist.* 95. *pp.* 114–128, *Oct.*, 1936.—The compound formerly known as $MgZn_5$ is shown to be more accurately described by Mg_2Zn_{11}. It belongs to the cubic class with Laue symmetry O_h and lattice parameter 8·53 Å. There are 3 mol. per unit cell, but it appears to be doubtful whether there are 32 or 33 Zn atoms per unit cell. The ternary alloy $Mg_3Cu_7Al_{10}$ also has a cubic structure with parameter 8·29 Å. J. I.

4971. Structure of the Low Temperature Modification of Thallous Iodide. L. Helmholz. *Zeits. f. Krist.* 95. *pp.* 129–137, *Oct.*, 1936. *In English.*—The paper contains the result of an X-ray study of crystals of the yellow modification of thallous iodide, which is stable at ordinary temperatures. The crystals are orthorhombic with unit cell dimensions as follows, $a = 5 \cdot 24 \pm 0 \cdot 02$ Å, $b = 4 \cdot 57 \pm 0 \cdot 02$ Å, $c = 12 \cdot 92 \pm 0 \cdot 01$ Å., the space group being D_{2h}^{17}. The density is 7·29 giving 4 mol. per unit cell. The parameters of each atom in the cell are tabulated. The structure has some of the characteristics of a layer lattice, in which each atom possesses five nearest neighbours. This structure accounts for some of the unusual properties of this compound. J. I.

4972. Thermal Conductivity in Relation to Crystal Structure. W. A. Wooster. *Zeits. f. Krist.* 95. *pp.* 138–149, *Oct.*, 1936. *In English.*—The author has collected the available data on the anisotropies in thermal conductivity of a series of crystals and has attempted to correlate them with their known crystal structure. The crystals are divided into three groups as follows: (1) structures in which the bonds are approximately of equal strength in all directions; (2) layer lattice types; (3) chain-like lattices. To five crystals in the first group a simple theory of conductivity anisotropy has been applied. The values for the anisotropies calculated according to this theory show reasonable agreement with those found experimentally. J. I.

4973. Oxidation of Metals. Part IV. Oxide Film on Aluminium. G. D. Preston and L. L. Bircumshaw. *Phil. Mag.* 22. *pp.* 654–665, *Oct.*, 1936.—The oxide film found on Al at room-temperature has been isolated by removing the metal by treatment in HCl gas at 250° C. Electron diffraction photographs of the film show that it is amorphous. Heating of the film at temperatures up to 650° C. does not induce crystallisation, but at a temperature of 680° C. crystallisation begins slowly. The film becomes a random mass of small crystals of cubic γAl_2O_3, the form of alumina which is present on the surface of molton Al. [For Part III see Abstract 1428 (1936).] AUTHORS.

4974. Diffraction of Kathode Rays by Vivianite. T. Yamaguti. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 372–379, *Aug.*, 1936. *In English.*—The space lattice of vivianite was investigated by kathode-ray diffraction, the results of which show that it is one-face (c) centred monoclinic having the following dimensions: $a = 9 \cdot 99_7$, $b = 13 \cdot 37$, $c = 4 \cdot 69_6$ Å and $\beta = 104° 16'$. Axial ratios derived are $a : b : c = 0 \cdot 749 : 1 : 0 \cdot 354$, where the value of c is found to be one half of that of c determined by mineralogists in the same ratio, *i.e.*, $a : b : c : = 0 \cdot 7494 : 1 : 0 \cdot 7034$. The refractive indices and the mean inner potential were obtained by the analysis of reflection spectra of the rays due to the cleavage plane (b). The decreases of the apparent refractive index in low order reflections were also observed. AUTHOR.

4975. Electron Diffraction from Galena Crystals. L. H. Germer. *Phys. Rev.* 50. *pp.* 659–671, *Oct.* 1, 1936.—Electron diffraction experiments are described on cleaved surfaces, on filed or ground surfaces of galena crystals. The cleaved surfaces show Kikuchi lines and diffuse spots; after etching the spots predominate. The filed surfaces consist of two types of regions. One is very similar to the cleaved surfaces;

the other is a deeply scratched type of surface which gives an entirely different diffraction pattern. Before etching, these surfaces give Debye-Scherrer rings; after etching a complicated pattern is obtained which indicates preferential orientation. The depth of the oriented layer of crystallites is found to be about 0·003 mm. It is suggested that these methods might be applied to a study of crystallite orientation and to the hardening of metals. The diffuseness of the lines and the number of spots obtained from the cleaved surfaces are due either to crystal imperfections or to thin projections; reasons are advanced for believing imperfections to be more likely. G. G.

4976. Structure of Isatin. Part I. E. G. Cox, T. H. Goodwin and A. I. Wagstaff. *Roy. Soc., Proc.* 157*A*. *pp*. 399–411, *Nov.* 2, 1936.—The failure of chemical and spectroscopic methods to decide between the lactam and lactim structures for isatin has suggested an attempt on the problem by X-ray methods. The present paper contains an account of the determination of the molecular arrangement in crystalline isatin, from which it is concluded that the structure is intermediate between the two. The molecules are found to be disposed in parallel layers in such a way that the N atom and adjacent O atom in one molecule approach very closely (2·8 Å) to the O and N atoms respectively in the next molecule. It is inferred from this that some type of coordination (N, OH, or " amino " bonds) occurs. Several related substances are also examined, but with the exception of 3-hydroxyquinolone, their structures do not appear to bear any marked similarity to that of isatin, and they have therefore not been studied in great detail. AUTHORS.

4977. Theory of Crystal Growth. R. Kaischew. *Zeits. f. Physik*, 102. 9–10. *pp*. 684–690, 1936.—The probabilities of the elementary addition or separation processes during crystal growth are mathematically discussed, and it is shown that the equation $kT \ln p_a / p_\infty = \phi_{\frac{1}{2}} - \overline{\phi}_a$ may be derived from purely kinetic considerations. H. H. Ho.

4978. Distribution and Geometry of Twin-Crystal Formation. H. Tertsch. *Zeits. f. Krist.* 94. *pp*. 461–490, *Sept.*, 1936.—The occurrence of twin crystals among minerals is examined statistically and the various types are classified. The author discusses the origin of twin crystals. J. I.

4979. Growth of Crystals from Nuclei. J. M. Anscheles. *Zeits. f. Krist.* 95. *pp*. 150–156, *Oct.*, 1936.—The author discusses the evidence which supports the theory of Fedorov that crystal growth takes place at the expense of nuclei in the surrounding liquid. To explain the formation of nuclei it is suggested that there is an optimum zone of " arbitrary " crystallisation surrounding the growing crystal. J. I.

4980. Change of Elastic Parameters of Single Crystals of Iron by Heating. K. Nakamura. *Tohoku Univ., Sci. Reports*, 25. *pp*. 364–380, *July*, 1936. *In English.*—The elastic coefficients of single crystals of iron have been determined, but not their change with temperature. Hence this change was investigated in the range of temperature from room-temperature to 500°, and the following empirical formulæ were deduced: $S_{11} = S^0_{11}\{1 + 4{\cdot}32,\ 10^{-4}\ (t-20) + 38{\cdot}8, 10^{-8}\ (t-20)^2\}$, $S_{12} = S^0_{12}\{1 + 1{\cdot}98, 10^{-4}\ (t-20) + 40{\cdot}8, 10^{-8}\ (t-20^2\}$, $S_{44} = S^0_{44}\{1 + 0{\cdot}44, 10^{-4}\ (t-20) + 17{\cdot}7, 10^{-8}\ (t-20)^2\}$, where S_{11}, S_{12}, S_{44}, are the principal parameters in Voigt's notation at a temperature t and S^0_{11}, S^0_{12}, S^0_{44} their values at 20°. AUTHOR.

4981. Electric Properties of Crystals. W. H. Bragg. *Roy. Inst., Proc.* **29. 2.** *pp.* **225–230** *and* **290–295, 1936.**—In Part I the author surveys the development of the theories of diamagnetism and describes how the diamagnetic susceptibilities of individual organic molecules are measured. In Part II the piezoelectric property of crystals is discussed and several technical and industrial applications are described. J. I.

4982. Gold and Copper in Rock-Salt and Synthetic Sylvine. M. J. Bogomolowa. *Acta Physicochimica,* **5. 2.** *pp.* 161–172, 1936. *In German.*—The diffusion of gold ions into crystals of rock-salt and sylvine is discussed. Tables are given showing the results of an investigation of the penetration of metal ions after heating crystals in contact with gold chloride at 700° C. for various periods of time. The mobilities of gold and copper ions in the above crystals are given for varying strengths of electric field and for different temperatures. J. I.

4983. Colloidal Gold in Sylvine Crystals. J. C. Repsche. *Acta Physicochimica,* **5. 2.** *pp.* 173–180, 1936. *In German.*—From measurements of the absorption coefficients of coloured KCl crystals the author obtains values for the dimensions of the particles of gold in the crystals. The observed absorption curves are compared with those calculated from theory. J. I.

***4984. High-Temperature Vacuum Debye-Scherrer X-Ray Camera. J. E. Dorn and G. Glockler.** *Rev. Sci. Instruments,* **7.** *pp.* 389–390, *Oct.,* 1936.—A Debye-Scherrer camera for taking powder spectrograms at high temperatures is described. For accuracy in temperature measurements it is designed so that the temperature may be measured directly by means of a thermocouple. The latter is directly adjacent to the point of impingement of the X-rays on the sample under investigation. C. J. B. C.

4985. Eddy Arrangement of Microcrystals in a Metallic Wire Caused by Drawing. T. Fujiwara and Y. Seiki. *Hiroshima Journ. Sci.* **6.** *pp.* 307–312, *July,* 1936. *In English.*—The arrangement of microcrystal grains in the cross-section of the drawn wires of Al and W is examined by means of X-ray radiographs and microscopical observation. It is found that in the cross-section of the drawn wire the microcrystal grains crushed by wire-drawing are rotated somewhat around the axis of the wire. The amount of the angular displacement of each crystal grain is so varied that the displacement is greater the nearer the layer in which the crystals are situated lies to the surface, and as a whole arrangement it seems as if the crystal grains are deformed in an eddy shape by wire-drawing. AUTHORS.

See also Abstracts 4956, 5077, 5092, 5096, 5097, 5159, 5178, 5187, 5197, 5241, 5242, 5268, 5269, 5279, 5299.

DENSITY.

See Abstracts 4941, 5003, 5026.

DIFFUSION AND OSMOSIS.

4986. Diffusion in Zeolitic Solids. M. H. Hey. *Phil. Mag.* **22.** *pp.* 492–497, *Sept.,* 1936.—The equations for the dissociation pressure and diffusion constant of the volatile component of a zeolitic compound deduced by the author [see *Min. Mag.* **24.** 129, 1935] give results in reasonable agreement with experiment for the systems $Pd\text{-}H_2$ and analcime-ammonia [see Abstracts 4092 and 4632 (1935)]. C. A. S.

4987. Diffusion, Viscosity and Intermolecular Actions in Binary Liquids. H. Lemonde. *J. de Physique et le Radium,* 7. *pp.* 371–378, *Sept.,* 1936.—A connected and somewhat fuller account of investigations the results of which have already been published [see Abstract 1470 (1936)]. C. A. S.

4988. Thermodynamic Extension of the Diffusion Equation. U. Dehlinger. *Zeits. f. Physik,* 102. 9–10. *pp.* 633–640, 1936.—It is shown theoretically that previously proposed general kinetic differential equations pass without further assumptions into Fick's law, by using the value of free energy applicable to ideal mixtures. The general equation can be used for investigation of diffusion even in non-ideal mixtures and this permits transformation of the measured effective diffusion coefficients into true removal coefficients. This is investigated for the system Au-Ni, thermal values being deduced from the constitution diagram. True removal coefficients are substantially greater for solid solutions than for the corresponding pure constituents. D. R. H.

4989. Diffusion of Gases Through Metals. Part IV. Diffusion of O_2 and of H_2 Through Ni at Very High Pressures. C. J. Smithells and C. E. Ransley. *Roy. Soc., Proc.* 157A. *pp.* 292–302, *Nov.* 2, 1936.—Recent theories of diffusion, in which adsorption at the gas-metal interface was assumed to be the controlling factor, indicate that the rate of diffusion should become independent of pressure at high pressures. The rate of diffusion of O_2 through Ni at 900° C. is measured and found to be independent of the O_2 pressure above 0·25 mm. This is shown to be due to equilibrium between the concentration of O_2 just inside the metal and the layer of nickel oxide formed on the surface, with which it is in contact. The rate of diffusion of H_2 through Ni is measured at pressures up to 112 atm. at 248° C. and at 400° C. The rate of diffusion is proportional to the square root of the pressure within the accuracy of measurement at the highest pressures. The rate of diffusion at 248° C. is also determined at pressures down to 3 mm., and shows the usual deviation from the square root law at pressures below 4 atm. A tentative theory of the mechanism of diffusion is advanced, which accounts for the continued effect of pressure after adsorption is sensibly complete. [For Part III see Abstract 2518 (1936).] AUTHORS.

4990. Osmotic Pressure of Methyl Celluloses. G. V. Schulz. *Zeits. f. phys. Chem.* 177. *Abt.A.* 6. *pp.* 453–459, 1936.—Measurements of osmotic pressure in a polymeric homologous series of methyl celluloses indicate a behaviour which deviates from that already found for other substances of high molecular weight. At concentrations below 0·5 % the osmotic pressure like the viscosity is normal, and at such concentrations simple fibre molecules exist in solution. At higher concentrations, deviations occur which at present cannot be interpreted with certainty. It is shown, however, that compounds which exhibit this behaviour must be specially classified (as incompletely substituted hydroxyl containing carbohydrates). H. H. Ho.

See also Abstracts **4982, 5020, 5242, 5268, 5269.**

ELASTICITY AND PLASTICITY.

4991. Analysis of Loaded Plates. D. L. Holl. *J. of Applied Mechanics,* 3. *A*81–*A*90, *Sept.,* 1936.—A study of certain simple plate problems is made by means of an approximate analysis. Thin homogeneous isotropic square plates are considered which are loaded at the central point and have various boundary conditions. The problems treated are those of a plate with (1) pinned or simply supported edges, (2) two opposite edges pinned and the other two free, (3) two opposite edges pinned and the other two clamped, (4) all four edges clamped, (5) all four edges free with only corner post supports. J. T.

4992. Flexure of Beams of Polygonal Cross-Section. B. R. Seth. *Phil. Mag.* 22. *pp.* 582–598, *Oct.*, 1936.

4993. Elastic Constants and Specific Heats of the Alkali Metals. K. Fuchs. *Roy. Soc., Proc.* 157*A*. *pp.* 444–450, *Nov.* 2, 1936.—Some mistakes in a recent calculation by the author of the elastic constants of the alkalis [see Abstract 431 (1936)] are corrected. The results for Na are compared with recent experimental results. An attempt is made to explain the observed fact that the specific heats of the alkalis show abnormally large deviations from a Debye function. AUTHOR.

4994. Radial Vibration of Spheres under Variable Radial Forces. B. Sen. *Indian Phys. Math. J.* 7. *pp.* 43–46, *Sept.*, 1936.—The radial vibrations of an elastic sphere under body forces varying with time and distance from the centre are investigated mathematically, the expression for the body force being supposed expanded in the form $r^{-\frac{1}{2}}\sum_{m=1}^{\infty} f_m(t)\mathrm{J}_{3/2}(k_m r)$, where k_m is the *m*th positive root of the equation $2\,ka\,\mathrm{J}'_{3/2}(ka) + \{3 - 8\mu/(\lambda + 2\mu)\}\mathrm{J}_{3/2}(ka) = 0$, the dash denoting a derivative. The case of the gravitating sphere is separately discussed. S. G.

4995. Theory of the Extensional Vibration of a Bar Excited by a Longitudinal Impact at the Fixed End, the Other End being Free. M. Ghosh and S. C. Dhar. *Calcutta Math. Soc., Bull.* 27. *pp.* 171–176, *Sept.–Dec.*, 1935.—Dealing in the same way as that for a load striking the free end of a bar [see Abstract 3441 (1936)], equations are obtained and solved to find the duration of contact of a load striking the fixed end. From the pressure equation, it is seen that in the case of a hard load, the duration of contact is constant and equal to $2l/c$, where l = the length of the bar and c the velocity of the longitudinal wave in it; the pressure jumps to a maximum, then falls exponentially. In other cases the pressure continually increases, reaches a maximum and gradually falls to zero; for an elastic load, the duration of contact is always greater than $2l/c$, but for a light and soft load, it is less than $2l/c$. H. M. B.

4996. Vibration of a Circular Ring. S. Ghosh. *Calcutta Math. Soc., Bull.* 27. *pp.* 177–182, *Sept.–Dec.*, 1935.—The rotatory inertia is introduced into the equations of free vibration of a rod in the form of a circular ring. The correction to be made to the period in the various cases is given and worked out as a percentage of the particular period for $c/a = 1/10$, where c is the radius of the cross-section of the ring and a that of its central line. The correction for flexural inertia, for flexural vibrations in the plane of the ring, is positive, being small for the graver modes but rising rapidly for higher ones, while for the same vibrations perpendicular to the plane, the corrections are similar but greater. Torsional vibrations require only a small negative correction for all modes. H. M. B.

See also Abstracts 4930, 5006, 5028, 5218.

GRAVITATION.

See Abstracts 5015, 5053, 5054, 5055, 5056, 5278.

HYDRODYNAMICS AND AERODYNAMICS.

4997. Whirlpools and Vortices. E. N. da C. Andrade. *Roy. Inst., Proc.* **29. 2.** *pp.* **320–338, 1936.**—A discussion, in simple and non-technical language, of various aspects of eddy motion in fluids. The subjects dealt with include the meaning of vorticity and circulation, the hollow eddy, Rankin's ' combined ' vortex, E. A. Poe's *The Descent into the Maelstrom*; waterspouts, bath-plug-hole whirlpools and related motions and the influence of the earth's rotation on the motion in such cases, smoke rings, vortex streets, the stability of flow between rotating cylinders, and the breaking up of jets and the influence of sound waves thereon. Researches of the author and of G. B. Brown on the manner in which jets break up to sound are reported. In the discussion of the influence of the earth's rotation on the movement of liquid towards a central orifice (the ' bath-plug-hole whirlpool ') experiments by Tumlirtz are reported in which the effect, very small with any ordinary sized vessel and usually completely masked by accidental causes, was successfully shown; and it is stated that the whirlpools formed in certain cases at the intake of the water for water turbines, where a large, still sheet of water flows away through a vertical pipe, show in the four recorded cases the sense of rotation to be anticipated from the sense of the earth's rotation (anti-clockwise when viewed from above in the northern hemisphere, clockwise in the southern hemisphere), and that the lines of flow have a curvature of the order of magnitude to be expected theoretically. S. G.

4998. Rotation of a Body with a Cavity Filled with Viscous Liquid. N. A. Slioskine. *Comptes Rendus,* **203.** *pp.* **508–511,** *Sept.* **7, 1936.**—A formal mathematical solution of the problem of the slow motion (inertia terms in the equations of motion neglected) of a viscous incompressible fluid inside a cavity bounded by a surface of revolution in a body which turns about the axis of symmetry of the cavity under the action of a given couple which is a function of the time. S. G.

4999. Uplift Pressure and Design of Weirs with Two Sheet Piles. G. Ram and V. I. Vaidhianathan. *Indian Acad. Sci., Proc.* **4A.** *pp.* **147–156,** *Aug.,* **1936.**—Models of weirs with two sheet piles are investigated for the pressure distribution. Three series of experiments are carried out. In the first series the sheet piles are of equal length at the heel and toe; in the second series, they are of unequal lengths but again situated at the heel and toe; and in the third series, the piles are of equal length but not at the heel and toe. The results obtained are represented graphically. The efficiencies of the sheet piles, with respect to their position under the floor and with respect to their length are examined. Employing the graphical results obtained in the investigation, a method of obtaining the uplift pressures for a new design is illustrated. The results of the graphical solution thus obtained are tested experimentally. The results by the two methods are found to agree giving a maximum difference of only 2·5 % for the uplift pressure and this not at an important point. Attention is also drawn to the fact that as the toe of a weir is its vulnerable point, weir design must commence from the downstream end, so as to control the exit gradient. [See also Abstract 1122 (1936).] AUTHORS.

See also Abstracts **5024, 5028, 5058, 5059, 5216, 5217.**

KINETIC THEORY OF MATTER.

See Abstracts **4988, 5116, 5189.**

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 5008.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

5000. Extension of Heaviside's Operational Method. T. Sakurai. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 356–371, *Aug.*, 1936. *In English.*—Though the operational method is the best for solving a large class of the linear differential equations of physics yet this method gives the answer only in cases in which conditions are given at one point, say at $x = x_1$, and the differential equation must be of constant coefficients with respect to x. The author extends the method to the solution of the equation when the conditions are given at two boundaries, say at $x = x_1$ and $x = x_2$, and the coefficients of the differential equation are the functions of x. Zero is used as operand and discontinuous unit functions are avoided. J. J. S.

5001. Quantitative Characteristic of the Qualitative Contact-Theory. N. Moissejev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 2. *pp.* 53–56, 1936. *In German.*—Theorems are proved in connection with Jacobian integrals. G. C. McV.

5002. Simplified Harmonic Analysis. E. L. Chaffee. *Rev. Sci. Instruments*, 7. *pp.* 384–389, *Oct.*, 1936.—The author gives full details of a method of harmonic analysis falling into the group in which ordinates are erected at selected points along the voltage axis. The method of selection is such that considerable advantage in simplicity is achieved. P. H. B.

5003. Effect of Isotopic Composition of Water on Fundamental Units of Volume and Temperature. E. H. Riesenfeld and T. L. Chang. *Phys. Zeits.* 37. *pp.* 690–692, *Oct.* 1, 1936.—The fact that water is a mixture of varying isotopic composition should be recognised in defining units of volume and temperature. New units are suggested in terms of pure light water, $H^1_2O^{16}$, which has a density $(260 \pm 10)\ 10^{-6}$ less than that of ordinary water. If l^* represents this new litre and l the old litre, $1l^* = (1\cdot00026 \pm 0\cdot00001)\ l = 1000\cdot29 \pm 0\cdot01$ cm.^{3}. At present there are objections to the new litre in that pure $H^1_2O^{16}$ is not directly available for its experimental determination, and the calculated data are still so uncertain that the volume of the new litre can only be known to 1/10 the accuracy of the old litre. Its introduction is thus premature, since, however, the volume of a litre is 0·0015 cm.^{3} smaller when determined with ocean water than with land water and also depends on the treatment, it is apparent that the water used should be specified. The introduction of the new litre affects specific gravities so that $S^* = 1\cdot00026S$. The melting point of $H^1_2O^{16}$ is —0·0014° C. and the normal boiling point 99·99945° C. Hence the new degree derived by dividing the fundamental interval by 100 is such that $1°^* = 1\cdot000008_5°$ C. The new calorie, *i.e.*, the quantity of heat required to raise 1 gm. $H^1_2O^{16}$ from $14\cdot5°^*$ to $15\cdot5°^*$ is influenced both by the new degree and the fact that the specific heat of $H^1_2O^{16} = 0\cdot99999$ times that of ordinary water. These effects practically cancel so that 1 cal* = 1·00000 cal. R. W. P.

5004. M. K. S. Electromagnetic Units (Giorgi) Applied to Electro-Acoustics. G. Sacerdote. *Alta Frequenza*, 5. *pp.* 570–575, *Sept.*, 1936.—The adoption of the M.K.S. Electromagnetic (Giorgi) units in the electrotechnical field can be extended also into the field of electro-acoustics. The advantages of greater uniformity and homogeneity in calculation are secured as are demonstrated by a practical example. J. E. B.

5005. Electrical Dimensions and Units. F. W. Lanchester. *Engineering*, 142. *pp.* 347–350, *Sept.* 25, *and pp.* 376–377, *Oct.* 2, 1936.—The author describes the quadrant system of units in which the units of mass and of length equal 10^{-11} gm. and 10^9 cm. respectively, and in which the coulomb, ohm, volt, ampere, henry, and weber are *absolute derived units*. Commenting on the M.K.S. system, it is suggested that the constant equalling 10^{-7} introduced in the I.E.C. reports as space permeability should in fact have the value 10^7 and not 10^{-7}. It is shown that the M.K.S. system is a congruent system, *i.e.*, it can be given the appearance of an absolute system by the introduction of a hypothetical fourth dimensional entity μ_0, but that in this it is by no means unique. Giorgi's claim for the M.K.S. system as enjoying perfect symmetry between electric and magnetic phenomena is controverted. W. S. S.

See also Abstracts 5067, 5068, 5072.

MECHANICS, CLASSICAL.

5006. Impulse in Isotropic Elastic Bodies. G. Arrighi. *Accad. Lincei, Atti*, 23. *pp.* 925–926, *June* 5, 1936.—For an indefinite elastic isotropic body, an equation connecting the variation of velocity with impulsive force is given. The equation is solved so that finally the variation of velocity is obtained in terms of the impulsive force and other quantities depending upon the position in the body. [See also Abstract 3104 (1932)]. H. M. B

5007. Motion of a Coil Spring. D. A. Wells. *Physics*, 7. *pp.* 395–398, *Oct.*, 1936.—The problem treated is that of finding the longitudinal motion of a long spring coil suspended vertically from a rigid support: the spring being sufficiently " soft " and long that it stretches appreciably under its own weight. Thus the tension and linear density each vary from top to bottom of the spring. A general solution involving displacements from the stretched static position is obtained and applied to three specific sets of boundary conditions: (1) the lower end free, (2) the lower end rigidly fixed and (3) with a weight attached to the lower end. The natural periods corresponding to the first three fundamental modes of motion for each of these three conditions have been determined experimentally for a long coil spring of piano wire and the results compared with the values computed theoretically. Before experimental results are given it is shown, by a second form of the equation of motion, that the natural frequencies of a spring are not affected by stretching. AUTHOR.

***5008. Reversing Gear and Its Uses. W. L. Balls.** *Journ. Sci. Instruments*, 13. *pp.* 318–322, *Oct.*, 1936.—A simple and sturdy form of reversing gear is described, followed by a description of its assembly into a general-utility recorder, where the pawl which operates the gear is moved by an electromagnet in response to a signal from the balance, extensometer, or other source. Finally, indications are given on improvements in the sensitivity of weighing which have been made possible by the use of this gear. AUTHOR.

See also Abstracts 4994, 5018.

MECHANICS, QUANTUM.

5009. Approximate Numerical Values of the Atomic Field and Radial Wave Functions of the Silver Ion (Ag^+). (Miss) M. M. Black. *Manchester Phil. Soc., Mem.* 79. *pp.* 29–33, 1934—1935.—

Results of calculations of approximate atomic fields and wave functions by the method of the self-consistent field are tabulated. These supply data for interpolating in the range Rb–Cs; the $(4d)^{10}$ group, which is complete in Ag, is very sensitive to small variations of the atomic field. N. M. B.

5010. Approximate Determination of the Atomic Wave Functions of Chromium. A. Porter. *Manchester Phil. Soc., Mem.* 79. *pp.* 75–81, 1934–1935.—Results are tabulated of some approximate calculations, made by the model differential analyser, of the atomic field of the Cr atom in two states of ionisation. The method is based on the self-consistent field. N. M. B.

5011. Unitary Equivalence of Self-Adjoint Operators and Constants of Motion. F. Maeda. *Hiroshima Journ. Sci.* 6. *pp.* 283–290. *July*, 1936. *In English.*—A dynamical system in quantum mechanics is considered as a unitary motion of a Hilbert space. The condition that an observable (whose value may depend upon the time) should be a constant of the motion is found. If the observable is independent of the time, it is a constant of the motion only if it is permutable with the Hamiltonian. G. C. McV.

5012. Statistical Quantum Mechanics and Thermodynamics. M. Delbrück and G. Molière. *Preuss. Akad. Wiss. Berlin, Abhandlungen, No.* 1. [40 *pp.*], 1936.—A detailed and comprehensive attempt is made to derive thermodynamical laws from statistical and quantum-mechanical considerations. Conditions necessary in using the calculus of probabilities, are fully discussed; for example, that the expression of a statistical law applies not to a single process but to a collection of processes, which may be incompletely determined. This essential indeterminacy is carefully emphasised, on account of its application in thermodynamical problems. In quantum-mechanical considerations, this indeterminacy, which remains finite and admits of probability statements, arises from the finite magnitude of the elementary processes of which observations are made. The probabilities of observed results can be obtained from a complex function, the distribution P, analogous to the classical distribution function used by Gibbs in his work on statistical mechanics. Matrix mechanical methods are used in dealing with the function P and the probabilities obtained from it. Mean values, canonical and micro-canonical distributions are discussed. Correspondences between quantities in the theory and thermodynamical magnitudes are given. Large and small systems are dealt with and finally the question of entropy is considered. Applications of the theory to special thermodynamical problems are given throughout the text. G. O. B.

See also Abstracts 4933, 4934, 4960, 4961, 4993, 5125, 5209, 5259, 5275, 5278.

RELATIVITY AND ETHER.

5013. Linearity of Lorentz Transformation. B. C. Mukherjee. *Indian Journ. Phys.* 10. *pp.* 237–243, *July*, 1936.—The linearity of the transformation between x, t which leaves $(\partial^2/\partial x^2 - (1/c^2)\,\partial^2/\partial t^2)\,u = 0$ invariant is established. G. C. McV.

5014. Fundamental Axioms of Relativity Theory. J. Meurers. *Zeits. f. Physik*, 102. 9–10. *pp.* 611–625, 1936.—It is shown that the theory of special relativity can be based on the invariance of certain abstract geometric forms and that all the physical deductions of the theory can be translated into properties of these forms. G. C. McV.

5015. Law of Gravitation and Parallel Displacement. J. Mariani. *Comptes Rendus*, 203. *pp*. 457–458, *Aug*. 24, 1936.—It is shown that the relativistic equations of motion in a gravitational field are deducible from the theory of finite and continuous groups of irrotational motions due to S. Lie. G. C. McV.

5016. Law of Gravitation. S. M. Sulaiman. *Indian Phys. Math. J*. 7. *pp*. 57–62, *Sept*., 1936.—The author asserts that for the motion of a particle in a plane around a gravitating centre the line element should be $ds^2 = (1 - 2\mu/D^2r)D^2dt^2 - (1 - 2\mu/D^2r)^{-1}\,dr^2 - r^2d\theta^2$, where D the finite velocity of gravitation which satisfies a certain equation of wave propagation. Applying the Einstein gravitational equations to this line-element, the author deduces a spectral shift for light coming from the edge of the sun's disc which is double Einstein's value and a deflection for light grazing the sun's disc, which is half as much again as Einstein's value. G. C. McV.

5017. Integral Electromagnetic Theorems in General Relativity. J. L. Synge. *Roy. Soc., Proc*. 157*A*. *pp*. 434–443, *Nov*. 2, 1936. —The general Green-Stokes theorem, connecting M-fold and (M + 1)-fold integrals in an N-space, is applied to space-time, yielding forms involving essentially positive elements of area, volume, and 4-volume. The indefinite character of the fundamental form in space-time is given explicit consideration, certain indicators (± 1) appearing in the formulæ on that account. The results are applied to the electromagnetic field in general relativity. Electric and magnetic intensities are defined, and it is shown that (I) the line integral of the potential 4-vector taken round a closed circuit is equal to the flux of magnetic intensity across any V_2 bounded by the circuit, (II) the flux of magnetic intensity across a closed V_2 is zero, (III) the flux of electric intensity across a closed V_2 is equal to the flux of electricity across any V_3 bounded by V_2. This last result yields, in particular, the classical electrostatic theorem of Gauss extended to general relativity. AUTHOR.

See also Abstract 5275.

SOLUTION.

5018. Application of Statistical Mechanics to the Absorption of Gases by Organic Liquids. S. Hamai. *Tohoku Univ., Sci. Reports*, 25. *pp*. 344–363, *July*, 1936. *In English*.—Examines the theoretical treatment of Hildebrand [see Abstract 2866 (1935)] with special reference to Guggenheim's objections [see Abstract 1214 (1935)]. For solutions of CO_2, N_2O and HCl in CCl_4, $C_2H_4Cl_2$, $C_2H_4Br_2$, $CHCl_3$, C_6H_6 and CS_2, the values of a particular constant calculated from solubility data do not agree too well with those derived following Hildebrand. Possible causes for the discrepancies are discussed, notably the effect of polarity and lack of symmetry in the solvent molecules and of inequality of molal volume as between solvent and solute. L. V. C.

5019. Significance of the Solubility Product of Very Insoluble Salts. E. Lange and K. Nagel. *Zeits. f. phys. Chem*. 177. *Abt.A*. 5. *pp*. 321–330, 1936.—Meaningless conclusions are reached when the solubility product of a very insoluble salt is used to determine the concentration of one ion in the presence of high concentrations of the other; thus for HgS ($P = 10^{-54}$), with $a_{S^{\cdot\cdot}} = 1$, $a_{Hg^{\cdot\cdot}} = 10^{-54}$, implying a concentration of one $Hg^{\cdot\cdot}$ ion in 10^{30} litres. This arises from the assumption of complete dissociation, which is thermodynamically defensible only at

higher concentrations where potentiometric measurements are applicable; for such very insoluble compounds the concentration of undissociated molecules must also be taken into account. Detailed thermodynamic and electrochemical analysis is given in the case of AgCl precipitation.
L. V. C.

5020. Theory of Binary Solutions. E. Hückel. *Zeits. f. Elektrochem.* 42. *pp.* 753–778, *Oct.*, 1936.—The first section of this theoretical paper is concerned with the general thermodynamical theory of binary solutions, vapour-pressure lowering being considered as an example. The theory of ideal solutions is expounded and the significance of osmotic pressure and the van't Hoff law is discussed. The second section deals with the special problem of the thermodynamical behaviour of solutions containing large chain-molecules. The thermodynamical treatment of the results of Meyer and Lühdemann is discussed. The author criticises the view of these workers that the inner-molecular movements of parts of the large molecules can contribute to the osmotic pressure by making the number of "kinetic units" greater than the number of molecules present. In the third section a statistical treatment of the osmotic pressure of ideal solutions is given, in which it is shown that parts of molecules performing inner-molecular motions cannot have the effect of free molecules.
L. A. W.

5021. Properties of Metallic Solutions. Part III. W. K. Ssementchenko, B. P. Bering, N. L. Prokrovsky, in collaboration with E. E. Shvareva. *Acta Physicochimica*, 5. 2. *pp.* 181–192, 1936. *In English.*—In the study of the surface tension of amalgams the authors have found it necessary to prepare pure specimens and an account is given of the mode of preparation of those used in the present and in former work [see Abstracts 3043 and 4035 (1936).] A complete series of values of the surface tension of the amalgams of Cs, Rb, K, Na, Li, Ba, Sr, Pb, Sn, Ag, Cu, Zn, Bi, Co, Mg and Cd at 18–20° C. is given. The data obtained for active metals at low concentrations satisfy Shishkovsky's equation but certain discrepancies are found in the experimental curves which are better represented by an equation derived by integrating the complete equation of Gibbs. The logarithm of the product of the constants in the Shishkovsky equation (= approximate value of the ultimate surface activation) is found to be a linear function of the difference of the generalised moments.
H. J. H. S.

See also Abstract 5092.

SURFACE TENSION AND COHESION.

5022. Calculation of Surface Tension from Experiment. Part IV. A. W. Porter. *Phil. Mag.* 22. *pp.* 726–729, *Oct.*, 1936.—Previous work [see Abstract 1509 (1936)] on the capillary rise with zero angle of contact in circular tubes of various widths is extended to angles of contact between 0° and 90° with the aid of Bashforth and Adams' tables. The values of $\Delta = (\beta^2 \cos a)/r^2 - h_0/2r$ are set out for $a = 0°, 15°, 30° \ldots$ 75° on suitable scales on two charts.
P. H. B.

5023. Parachors of Metal Carbonyl Compounds. J. S. Anderson. *Chem. Soc., J. pp.* 1283–1286, *Sept.*, 1936.—The surface tensions and parachors of $Ni(CO)_4$, $Co(CO)_3(NO)$, $Fe(NO)_2(CO)_2$, and $Fe(CO)_5$ have been determined. The apparent parachor of the central atom shows that in all these compounds there is a large anomaly, such as has been found with other coordination compounds. It is concluded that no adequate explanation of this anomaly has yet been advanced. AUTHOR.

5024. Drainage of a Liquid Film from a Vertical Plate. G. Green. *Phil. Mag.* 22. *pp.* 730–736, *Oct.*, 1936.—Jeffreys [see Abstract 2995 (1930)]assumes that the motion at any point within the draining film may be regarded as practically a steady fluid motion, and on this basis a solution representing the profile of the film in the later stages of the motion is obtained. In the present paper the initial motion within the film is taken into account in the hope of removing discrepancies hitherto found between theory and experiment. Adequate tests of the new theory could not be made with the data at the author's disposal. P. H. B.

5025. Selective Wetting of Metals in Presence of Electrolytes. Part I. D. Mirlis and P. Rehbinder. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 3. *pp.* 123–128, 1936. *In English.*—Carefully cleaned small metal plates were placed in purified benzene, and a drop of electrolyte or of pure water was then placed on the plate. The contact angles were measured on photographs of the projected images of the drops. The rate of change of the contact angle as the drop spreads is connected with the hydrophilisation of the metal surface produced by products of corrosion accumulating near to the wetting periphery. Upon introducing into a non-polar hydrocarbon phase some surface-active substance which is chemically fixed in an adsorption layer (fatty acid) on metal, the initial value of the contact angle of a drop, corresponding to the natural hydrophobe metal, remains almost constant, or may even show a slight tendency to rise with time, particularly when there is a possible reaction of a fatty acid with the corrosion products (*e.g.*, on iron). P. H. B.

See also Abstracts 4993, 5021, 5026, 5106.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 5213.

VISCOSITY, FRICTION AND LUBRICATION.

5026. Properties of Liquid Binary Systems in which Compound Formation Occurs. E. Angelescu and C. Eustatiu. *Zeits. f. phys. Chem.* 177. *Abt.A.* 4. *pp.* 263–276, 1936.—The physical chemical properties are derived for certain liquid binary systems consisting of an aromatic amine and a fatty acid, which depend on the intermolecular free space. The volume contraction of such an admixture is calculated from the interpolation formula: $\phi = K \cdot x^a \, (1 - x)$, which affords particularly accurate results in the vicinity of the maximum. The viscosity of the mixture possesses a distinct maximum, which is displaced towards the more strongly associated components and may be calculated by means of the McLeod formula. The properties which depend on the surface tension (molecular surface energy, parachor) exhibit deviations from the additive rule, but may be computed from a consideration of the volume contraction by a formula of the form: $E = [E_1 \cdot x + E_2 \cdot (1 - x)] \cdot (1 - K \cdot \phi)$, where E is the property concerned; the value of K depends on the number of C atoms in the acid molecule and its magnitude increases with the active capillary strength of the acid. While the molecular refractions of the mixtures are almost additive, the refractive indices exhibit deviations from this rule, the maximum deviation being given for a proportion of about one molecule amine to two molecules of acid. H. H. Ho.

5027. Viscosity of Liquid Sodium and Potassium. Y. S. Chiong. *Roy. Soc., Proc.* 157*A*. *pp.* 264–278, *Nov.* 2, 1936.—The viscosity of liquid

Na and K is measured by the oscillating sphere method, in which the liquid is enclosed in a glass sphere, and its viscosity calculated from the damping of the oscillation. The alkali metals are chosen because their simple crystal structure has advantages for comparison with theory. The measurement was done from the immediate neighbourhood of the melting point up to about 360° C. Results obtained for both Na and K are found to obey satisfactorily the two viscosity formulæ of Andrade. AUTHOR.

5028. Slow Viscous Flow and Elastic Deformation. J. N. Goodier. *Phil. Mag.* 22. *pp.* 678–681, *Oct.*, 1936.—The recent papers of Gemant and Yates-Fish [see Abstract 1319 (1936)] and the 'First Report on Viscosity and Plasticity' of the Committee of the Amsterdam Academy of Sciences (1935), suggest that full advantage is not being taken of the analogy between slow steady viscous motion and elastic deformation. The author points out that this analogy enables the taking over from the theory of viscous flow of solutions of the elastic problems arising in the dipole theory, and the taking over from elasticity of formulæ and observations of which the theory of viscosity measurements stands in need. Full appreciation of it would also prevent further duplication of analysis in the solution of analogous problems in the two theories. H. H. Ho.

5029. Composition and Conductivity of Oils and Waxes. A. Gemant. *E.R.A. Report* (*Ref. E/T* 48). *Inst. Petroleum Technologists, J.* 22. *pp.* 646–662, *Sept.*, 1936.—The conductivity-temperature curve of oils and waxes in the melting region allows certain conclusions to be reached as to their composition. For this purpose, a theory is put forward that such systems consist of two phases: a crystalline and a glassy or amorphous one, both having their characteristic conductivities and determining the total conductivity by their volume-ratio. This assumption accounts for the characteristic shape of the curve possessing a pronounced maximum. At the same time the distribution curve of the individual components among the different melting points in the mixture can be deduced. The rigorous construction of the chemical composition would require the knowledge of other physicochemical data, especially of the equation for the depression of freezing point for concentrated solutions, in absence of which only an approximate computation is possible. In addition, the theory explains the observed dielectric absorption of oils in the transition region. The theory is developed quantitatively, and three examples of numerical calculation on experimental data are given. These data refer to a lubricating oil, a cable oil and paraffin wax. AUTHOR.

5030. Internal Friction of Solids. K. Bennewitz and H. Rötger. *Phys. Zeits.* 37. *pp.* 578–588, *Aug.* 15, 1936.—The authors develop a theory to account for internal friction of solids in which the diffusion of a certain property styled *Fehlstellen* is calculated. The theory predicts that the friction should vary with frequency and that at a certain frequency it should pass through a maximum. The periodic time corresponding to this frequency is called the relaxation time. Experiments are made with various materials such as Al, Fe, Ag, Cu and glass to test the theory, considerable attention being paid to sources of error. In each case a maximum is observed and agreement with the theory is obtained. While, however, there is a definite frequency corresponding to the maximum in the case of Al and brass there is apparently a band of frequencies in the case of the other materials. J. E. R. C.

See also Abstracts 4987, 5024.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***5031. Photographic Photometry. F. E. Ross.** *Astrophys. J.* 84. *pp.* 241–269, *Oct.*, 1936.—A thermoelectric photometer is described, and the theory of photometric measurement is developed. The influence of variable fog on the photographic plate, including the Eberhard effect, is investigated. It is shown that, in general, the ratio of the galvanometer deflection for the star to that for the fog in the immediate neighbourhood is a measure of stellar magnitude. Experimental evidence is adduced. Since the standards of magnitude (the Polar Sequence) are located at the pole, the effects on photometry of the unavoidable errors of adjustment of the polar axis of the instrument, especially serious in long exposures, are pointed out and steps which should be taken for their reduction are suggested. The difficulties always met in the photometric measurement of plates taken with wide-angle lenses—in particular, distance errors—are discussed. The background effect, due to unresolved clusters and to dark and bright nebulæ, is shown to be inappreciable. Experiments were made to determine the best method of development. It was found, unexpectedly, that development without rocking or agitation of any kind gave superior results. A catalogue of the magnitudes and approximate positions of all stars as bright as 12·0 photovisual magnitude in the BD zones 88° and 89° is given, with a chart for identification. Comparison is made with Seares's values for normal distribution and mean colour indices. AUTHOR.

COMETS AND METEORS.

5032. Origin of Comets. P. Bourgeois and J. F. Cox. *Comptes Rendus*, 203. *pp.* 451–453, *Aug.* 24, 1936.—The correlation between the eccentricity of the orbits of comets moving in ellipses and the inclination of the orbits to the galactic plane confirms the theory of the galactic origin of comets. In order that a comet with elliptic orbit should arise, the velocity of the comet must be perpendicular to the stream-lines of the galaxy at the moment when the body enters the sun's sphere of influence. G. C. McV.

5033. Meteor Heights from the Arizona Expedition. E. Öpik. *Nat. Acad. Sci., Proc.* 22. *pp.* 525–530, *Sept.*, 1936.—An immense amount of material was collected by the expedition, which is gradually being studied and published [see Abstract 4906 (1934)]. 3540 of the meteors were recorded from 2 stations, and their heights calculated. The observations were distributed over the years, and it appears that meteors belonging to major showers were only 7 % of the total number, sporadic 80 % : this fact is specially favourable for correlating height with other characters. Meteors meeting the earth are vaporised 23 km. higher up than those overtaking us, owing to greater velocity and kinetic energy ; average height decreases during the night, due probably to gradual cooling of the upper atmosphere ; height increases with decreasing luminosity ; a seasonal variation in height suggests an annual fluctuation of height of the atmosphere. Meteors of major showers have a considerably greater range in height (difference of height at appearance and disappearance) than sporadic, also a smaller heliocentric velocity ; shower meteors are solar and mostly stones, sporadic extra-solar and mostly irons. The majority are extra-solar. The upper atmosphere (at about 90 km.) has a temperature of about 100° C. with the same average molecular weight as at sea-level, or else a lower temperature with smaller molecular weight. A hydrogen atmosphere cannot exist, at least to a height of about 130 km. M. A. E.

COSMOGONY.

5034. Rate of Disappearance of the Proper Motion of a Nebula According to the Expansion Theory. N. R. Sen. *Calcutta Math. Soc., Bull.* 27. *pp.* 101–110, *Sept.–Dec.,* 1935.—It is shown that, if a nebula possesses a proper motion of measurable amount, then the relativistic theory of the universe enables an estimate to be made of the duration of the expansion of the universe, provided that the nebula and the observer were initially coincident. From present data on nebular proper motions, periods of the order of 10^9 years for the time of expansion can be deduced.

G. C. McV.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

5035. Approximate Calculation of the Precession of the Equinoxes. J. Chazy. *Comptes Rendus,* 203. *pp.* 455–457, *Aug.* 24, 1936.—It is shown that a good approximation to the value of the precession of the equinoxes can be found if the orbits, relative to the earth, of the sun and moon are taken to be circular and if the earth is supposed to be a homogeneous sphere together with a solid ring of matter arranged along a great circle. In addition it is assumed that the axis of revolution of the solid representing the earth makes a constant angle with the ecliptic. G. C. McV.

NEBULÆ.

5036. Luminosity Function of Nebulæ. Part II. E. Hubble. *Mt. Wilson Observat., Contrib. No.* 549. *Astrophys. J.* 84. *pp.* 270–295, *Oct.,* 1936.—Velocity-magnitude relations ($\log v = 0{\cdot}2m + c$) are derived from apparent magnitudes of (*a*) brightest stars in resolved field nebulæ, (*b*) field nebulæ of all types, and (*c*) fifth brightest nebulæ in clusters. Since the absolute magnitude of brightest stars, $\bar{M}_s$, is known, $\bar{M}_n$ and $\bar{M}_c5$ are indicated by the values of *c* in the three relations. Residuals in the relation for field nebulæ of all types indicate the form of the luminosity function as distorted by peculiar motions. The effects of the distortion are reduced in velocity-distance relations ($v = kd$) derived from (*a*) brightest stars and (*b*) field nebulæ. The coefficient *k* is about 526 km./sec. per million parsecs, and the dispersion of peculiar motions is about 200 km./sec. The luminosity function derived from the residuals agrees closely with that determined in Part I [see Abstract 4058 (1936)] from brightest stars in resolved nebulæ alone. The various types of nebulæ are comparable, with the exception of the irregulars, which average about half as bright as the others. The distance of the Virgo cluster is found to be of the order of $2{\cdot}3 \times 10$ parsecs ($m - M = 26{\cdot}8$).

AUTHOR.

See also Abstracts **5034, 5042.**

STARS.

5037. Low-Dispersion Spectra of Red Stars. R. Wildt. *Mt. Wilson Observat., Contrib. No.* 551. *Astrophys. J.* 84. *pp.* 303–318, *Oct.,* 1936.—Over the range from λ 3000 to λ 9000 (total dispersion 3 mm.

approximately) the spectra of selected late-type stars have been compared. M giants and N stars are marked by a continuous absorption of wavelengths shorter than λ 4000, the amount being of the order $0{\cdot}5^{m}$ and $2{\cdot}5^{m}$, respectively. Types S and gM cannot be distinguished on low-dispersion spectrograms. Dwarfs of class M have a strong u.v. spectrum and R stars a fairly strong one. Various absorption bands are found in the far u.v. and are attributed tentatively to CN, CH, NH, OH, CaH. The classes R and N are possibly to be regarded as forming separate, parallel branches. The hypothetical physical processes causing the continuous u.v. absorption in gM and N Stars are discussed. AUTHOR.

5038. Stellar Atmospheres. H. Lambrecht and B. Jung. *Naturwiss.* **24.** *pp.* 577–582, *Sept.* 11, 1936.—A semi-popular account of present-day theories of stellar atmospheres is given. The theories of the photosphere, of the chromosphere and of emission lines in planetary nebulæ are all reviewed. G. C. McV.

5039. Stars in High Galactic Latitudes. K. G. Malmquist. *Astron. Iakttagelser och Undersökning., Stockholms,* **12.** 7. [130 *pp.*], 1936.—Photographic magnitudes and colour indices of about 4500 stars near the North Galactic Pole in continuation of an earlier investigation on colours and magnitudes of 3700 stars within 10° of the North Galactic Pole.

5040. Spectrum of Nova Herculis. N. T. Bobrovnikoff. *Am. Phil. Soc., Proc.* **76.** 4. *pp.* 497–521, 1936.—Absorption and fainter emission lines in the visual spectrum of the Nova have been studied in detail. Among 150 measured absorption lines 88 have been identified and 62 could not be properly assigned to any element. The following elements were represented by spectral lines in the visual region: AlII, AlIII, CrII, FeI, FeII, H, MgI, NII, NaI, OI, SII, ScII, SiII, TiII, YII. The spectrum of the Nova during January 1935 was compared with the spectra of B and A type stars. The greatest correspondence was found between the spectrum of α Cygni and that of the Nova. The observations on the spectrum of the Nova in the visual region made at other observatories were found to be in agreement with the writer's results. Many spectroscopic phenomena considered to be peculiar to Nova Herculis were shown to have been observed in other Novæ. [See also Abstract 2612 (1936).] AUTHOR.

5041. Temperature Variations in Nova Herculis. H. Oehler. *Zeits. f. Astrophysik,* **12.** 5. *pp.* 281–312, 1936.—The paper is in two parts: (1) 11 spectrograms of the Nova and a comparison star, ι Herculis, were taken at intervals during early 1935. From the spectral-energy curves thus obtained, values of the effective temperature of the Nova are derived; they range from 10000° K. in late Dec. 1934 to 19000° K. in mid-March 1935. This rise is broadly in accord with the results of Beileke and Hachenberg [see Abstract 4905 (1935)], but some divergences are discussed. (2) 9 spectrograms taken in the period June–Sept. 1935 show bright emission bands characteristic of the nebular stage of the Nova's evolution. Values of the ionisation temperature of the exciting nucleus are obtained from the intensity ratios of (*a*) the nebular [O III] lines and the Balmer lines (after Stoy), and (*b*) λ 4686 (He II) and Hβ (after Ambarzumian). Method (*a*) gives a series of values ranging from 31000° K at the end of July to 125000° K in mid-Sept., whereas method (*b*) gives values all close to 70000° K. Reasons for the discrepancies are discussed. A. Hu.

5042. Characteristic Temperatures in Super-Novæ. F. Zwicky. *Nat. Acad. Sci., Proc.* 22. *pp.* 557–561, *Sept.*, 1936.—The author adduces new evidence in verification of the Super-Novæ hypothesis [see Abstracts 2804, 2805 (1934)] and gives qualitative estimates of the total energy E_t, suggesting three methods of estimating the temperature T_s. He visualises two critical surfaces on Super-Novæ, Σ_b (boundary surface) and Σ_s (surface of separation) which he defines as the smallest surface which contains most of the Nova's matter remaining after the gases are ejected. He gives examples of T_s from S-Andromedæ and N.G.C. 4273. He finds that E_t not only includes E_{vis} [see Abstract 3544 (1936)], but also invisible radiation, the kinetic and the gravitational potential energies of the ejected gases, the electric potential energy caused by the separation of oppositely charged gaseous clouds whose subsequent breakdown of the potentials generate cosmic rays from Super-Novæ [see Abstract 3178 (1936)]; and the heat content of the central star. The ratio E_t/E_{vis} increases rapidly with increasing absolute luminosity of the Nova. A. S. D. M.

5043. Spectrum of P Cygni. O. C. Wilson. *Mt. Wilson Observat., Contrib. No.* 550. *Astrophys. J.* 84. *pp.* 296–302, *Oct.*, 1936.—An examination of spectrograms of P Cygni taken at the Lick and Mount Wilson Observatories has shown that the Balmer lines in this star consist of an emission component and two absorption components, instead of one as formerly supposed. These two absorption components vary in intensity (and probably in position) in such a way that on some occasions both are visible, while on others only one or the other is to be seen. No period for the variation can be deduced from the available material, but it is demonstrated that significant changes have occasionally occurred within intervals of the order of one month. The He lines also appear to pass through a similar cycle in step with those of H. AUTHOR.

See also Abstracts 5031, 5036.

SUN.

5044. Motions of Prominences. E. Pettit. *Mt. Wilson Observat., Contrib. No.* 552. *Astrophys. J.* 84. *pp.* 319–345, *Oct.*, 1936.—Collected data for 40 eruptive prominences show that their upward velocities are liable to sudden impulsive increases occurring at intervals of the order of an hour. Such increases are small integral multiples of the initial velocities. Tenfold increases of speed in a few hours are not uncommon. The maximum heights attained are of the order of 300,000 km., though one of 800,000 km. has been recorded. Any change in the heliographic position angle which may occur during the life of an eruptive prominence seems to be proportional to its speed of ascent. Records since 1915 show that only 1·3% of sunspots are accompanied by prominences; three sub-divisions of this "sun-spot" type are illustrated. Where prominences send streamers into centres of attraction or sunspots, the streamers, too, suffer impulsive increases of velocity occurring in integral steps. Retarded eruptions in which the velocities attained are only a few km./sec., and small short-lived eruptions, moving at as much as 500 km./sec. are described. A. Hu.

5045. Absolute Photometry of the Solar Corona. B. Fesenkov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 6. *pp.* 223–225, 1936. *In French.*—A method is developed for eliminating the effect of the illumination of the earth's atmosphere on photometric measures of the corona during total eclipses, when the measurements refer to distances of 25′–30′ from the edge of the sun's disc. G. C. McV.

5046. Proportion of Polarised Light in the Corona. J. Dufay and H. Grouiller. *Comptes Rendus*, 203. *pp.* 453–455, *Aug.* 24, 1936.—The final results of the polarisation measurements made during the total eclipse of 31 Aug., 1936 are given. In the range 4000–5700 Å, polarisation of the coronal light is practically independent of wave-length. The proportion of polarised light attains a flat maximum of about 0·26 at 10′ distance from the solar edge. It is found that the brilliance of the sky is uniform from the centre of the lunar disc to beyond the corona so that the effect of the sky on the proportion of polarised light from the corona may be calculated by supposing that polarisation is negligible near the sun's disc. The origin of the continuous spectrum of the corona is attributed to neutral scattering of sunlight by free electrons. G. C. McV.

5047. Change of Solar Velocity with Distances of Stars from Galactic Plane. Emma T. R. Williams. *Astrophys. J.* 84. *pp.* 346–353, *Oct.*, 1936.—The analysis of the proper motions of 18,000 stars, made at the McCormick Observatory, together with several previous investigations of proper motions, of radial velocities, and of space motions, indicates that the solar velocity decreases with respect to stars of a given spectral class, at increasing distances from the galactic plane. The investigations in which no stars were excluded on account of high velocity or stream membership, such as the McCormick analysis, show the effect more clearly than those in which such stars were excluded. AUTHOR.

5048. Fraunhofer's Spectrum in the Interval from 77,000 to 110,000 Å. A. Adel and V. M. Slipher. *Astrophys. J.* 84. *pp.* 354–358, *Oct.*, 1936.—Recent observations of 100 fine structure lines in the solar grating spectrum, lying in the interval from 77,000 to 110,000 Å, are described in connection with previous measurements of the solar prismatic spectrum [see Abstract 2461 (1935)]. AUTHORS.

5049. Theoretical Intensity Distribution in the Wings of Fraunhofer Lines. M. Minnaert. *Zeits. f. Astrophysik*, 12. 5. *pp.* 313–322, 1936.—The intensity distribution in the wings of a Fraunhofer line at great distance from the line centre is calculated for the different points on the solar disc, the absorption and scattering coefficients being arbitrary but given functions of depth. Instead of using the customary approximation for the black radiation $E_\lambda = E_{\lambda,0} (1 + b\tau)$, the complete form of the function $E_\lambda (\tau)$ has been taken into account. The resulting formula is given in a form suitable for practical calculation. M. A. E.

See also Abstracts 5069, 5075, 5316.

GEOPHYSICS.

GEODESY.

See Abstracts 5053, 5054, 5055, 5056.

GEOPHYSICS, APPLIED.

5050. Interpretation of Electrical Resistivity Measurements. A. Belluigi. *Beitr. z. angew. Geophys.* 6. 1. *pp.* 14–24, 1936. *In Italian.* —The various empirical rules used in electrical resistivity prospecting for determining from the curves the depth of the active horizons can lead to serious errors, especially when several horizontally-bedded media are active in succession. The author instances examples and arguments in favour of the " components method " employed constantly in his own practice. Tagg's method is acknowledged to be sufficiently accurate when only two beds are in question, but is inapplicable when more than two are concerned. E. L.-J.

5051. Theory of Electrical Coring. A. Belluigi. *Beitr. z. angew. Geophys.* 6. 1. *pp.* 25–37, 1936. *In English.*—The method of electrical prospecting known as electrical coring consists in translating a 4-electrode resistivity system of which one current electrode remains on the surface and the two pick-up (potential) electrodes and the second current electrode are kept at fixed intervals apart—along an uncased drill hole. Measurements are taken of the resistivity of the system at various stages of the descent, and indications of the electrical properties of the adjacent strata at various depths are thereby obtained. The author discusses the formula for correlating the measured resistivities to the strata resistivities, for various usual and unusual electrode arrangements, differing in regard to the relative positions of the potential and lower current electrodes. He shows that in some cases it is advantageous to depart from the customary arrangement used by Schlumberger. The correlation of the planes of discontinuity of resistance in simple two- and three-layer cases with the kinks in the resistivity curve is examined ; also the cases of a spherical " disturbing mass " intersected by the borehole, or on the flank of the latter, are considered. E. L.-J.

5052. Interpretation of Magnetic Anomalies. F. Bahnemann. *Beitr. z. angew. Geophys.* 6. 1. *pp.* 38–46, 1936.—Interpretation of magnetic data obtained in geophysical prospecting involves certain theoretical analysis of the effects due to hypothetical disturbing bodies, situated at varying depths below the surface on which measurements are made. To compute the theoretical effects of such bodies, simple assumptions must be made as to the distribution of magnetisation throughout the body, whether it is residual or caused solely by induction of the local terrestrial field. One simple assumption, due to Nippoldt, replaces each body by one or more simple magnetic poles, of appropriate strengths and positions within the actual body. The author discusses cases in which this simple hypothesis is replaced by an extension, the polar elements being replaced by linear elements, which correspond more to the usual practical case in prospecting, where magnetic plates and veins are encountered, having one or two dimensions very small compared to their others, and to their depth below surface. The formulæ for linear elements are obtained, and graphs given for typical cases of two elements. A practical example of interpretation in South Africa is noted. E. L.-J.

***5053. Holweck-Lejay Gravimeter. F. Holweck.** *Bull. géodésique,* 46. *pp.* 295–303, *April–May–June,* 1935.—Instruments of the gravimeter type are designed to accelerate the determination of the force of gravity *g* at a large number of stations within an area of several thousand square miles, with the object of amplifying geodetic and geophysical data obtained at relatively scattered positions by means of the standard invariable pendulum. The Holweck-Lejay gravimeter employs an inverted elastic pendulum supported by a lamellar spring, in which the effect of *g* as a restoring force is very nearly balanced by the elastic torque of the supporting strip. In this way the sensitivity of the pendulum is very greatly magnified, and a long period of oscillation is obtained with a relatively light and portable apparatus. To ensure reasonable accuracy, careful protection from temperature effects is essential. The supporting strip is made of elinvar, and the pendulum arm of quartz supports a mass of only a few grammes. The whole system is mounted within a vacuum chamber. A measurement of *g* at one station occupies about an hour or two, and the apparatus can be rapidly transported within a motor-truck, within which it is supported by elastic suspensions. On test, one observer measured *g* at 153 stations in China, covering an area of 500,000 km^2. in a single year. Comparison with standard pendulum observations showed an average error of 1·1 milligal. E. L.-J.

***5054. Measurements with Holweck-Lejay Gravimeter. P. Lejay.** *Comptes Rendus,* 203. *pp.* 13–16, *July* 6, 1936.—Gives a table of values of *g* measured at 57 stations by means of apparatus No. 42. Later observations were repeated with another instrument No. 510, and concorded well with the observations made with No. 42. The precision of measurement was about 2 milligal. E. L.-J.

***5055. Accuracy of Measurements with Thyssen Gravimeter. A. Schleusener.** *Beitr. z. angew. Geophys.* 6. 1. *pp.* 1–6, 1936.—It is well known that it is difficult to reproduce former gravity measurements obtained from pendulum observations within several milligal. The question therefore arises as to whether measurement with the Thyssen gravimeter can be repeated to a greater degree of accuracy. An important consideration is the ability to reproduce the accuracy of a previously made instrument. In addition to the original first field gravimeter No. 3, four others, Nos. 4–7, have been constructed recently, and a further four, Nos. 8–11, in the spring of 1936. Tests of repetition observations are cited, showing that in the later constructions, the accuracy attained is now of the order of 0·25 milligal, compared with 1 milligal in the original instrument, and it is expected that in the near future, the accuracy obtained will approach 0·1 milligal. E. L.-J.

***5056. Gravimeter Operated over Large Distances. S. v. Thyssen.** *Beitr. z. angew. Geophys.* 6. 1. *pp.* 7–13, 1936.—The use of the Thyssen gravimeter as a geodetic instrument, for determining the value of *g* at points on the earth's surface separated by some miles, is considered. Tests in Germany have established that, on traverses which included stations separated by more than 50 km., the average error remained below 0·5 milligal. Up to 450 km. traverses could be measured in 12 to 15 hours, and the possibility of substituting gravimeters for pendulums in geodetic measurements is proved to be practicable. E. L.-J.

HYDROSPHERE, PHYSICS OF THE.

***5057. Simple Portable Tide-Gauges. C. K. Wentworth.** *Washington Acad. Sci., J.* 26. *pp.* 347–352, *Sept.* 15, 1936.—A description of certain simple portable tide-gauges for determinations within 0·1 or 0·2 ft., with a discussion of the accuracy of measurement of a manometer-and-syphon-type gauge with particular reference to measurements on the Oahu coast. S. G.

See also Abstracts 4941, 5119.

LAND, PHYSICS OF THE.

5058. Flow of Heterogeneous Fluids through Porous Media. M. Muskat and M. W. Meres. *Physics,* 7. *pp.* 346–363, *Sept.*, 1936.—On the basis of experiments by Wyckoff and Botset differential equations are found governing the flow of heterogeneous fluids through porous media. Simple steady-state solutions are found and the distributions of pressure, permeability and saturation presented graphically. An approximate and numerical method for dealing with transient systems is described and an example of a linear transient flow completely worked out. The bearing of the solutions on problems arising in the production of oil from underground reservoirs, and the effects of gas segregation and of deviations of the free gas phase from ideal behaviour, are discussed. [See following Abstract.] S. G.

5059. Flow of Gas-Liquid Mixtures through Unconsolidated Sands. R. D. Wyckoff and H. G. Botset. *Physics,* 7. *pp.* 325–345, *Sept.*, 1936.—The flow of gas-liquid mixtures through unconsolidated sands was studied experimentally to obtain a generalisation of Darcy's law, and results given for four sands of widely different permeabilities with CO_2 and water as fluids. The apparent permeability of the medium to either component is variable and depends in a complex manner on the relative concentration of the two fluid components. A relation is found between permeability and liquid-saturation whose generalisation to all unconsolidated sands seems permissible. For all gas : liquid ratios below a certain critical value the steady state condition for a given sand is always reached at the same saturation and permeability ; the significance of this " equilibrium " permeability and liquid-saturation is discussed. Applications to petroleum technology are briefly mentioned. [See preceding Abstract.] S. G.

5060. Origin of Continents and their Motions. R. Gunn. *Frank. Inst., J.* 222. *pp.* 475–492, *Oct.*, 1936.—Geophysical data emphasise the unusual nature of the Pacific basin with its encircling mountain chains and suggest that the sub-Pacific layers of appreciable strength are 1 to 2 % denser than elsewhere. It is shown that, as a result of this asymmetry and the isostatic adjustment of the continents, the mass per unit area of the earth's outer shell in Pacific regions is about 0·03 % greater than in the continents. This mass asymmetry produces geologically important tangential forces on the continents of gravitational origin which frequently compress their boundaries, playing an important part in mountain building and may produce continental motions. The force on N. America urging it to S. and W. is approximately 10^{25} dynes and is adequate or nearly adequate to crush or produce over thrusting in the resisting Pacific basin, permitting continental motion with a velocity of the order of an inch per year. The theory of the earth's origin is particularly adapted to describe the origin of the continents and the observed asymmetry of their distribution. R. S. R.

METEOROLOGY.

5061. Atmospheric Radiation. P. K. Raman. *Indian Acad. Sci., Proc. 4A. pp.* **243–253,** *Aug.,* **1936.**—The paper discusses the results of measurements of nocturnal heat radiation received from the atmosphere at Poona and Sinhagad. The measurements were carried out in Feb. and March, 1935, with Ångström pyrgeometers. Simultaneous measurements were made at the Agricultural Meteorological Observatory and the top of the tower of the Poona Meteorological Office and also from the latter and the top of Sinhagad, a hill 2,500 ft. above Poona level and distant 15 miles from Poona. It is shown that on clear nights at all the three places there was a decrease of radiation from the atmosphere after sunset and that the decrease was a maximum at ground-level and minimum at Sinhagad. This decrease expressed as a fraction of the change in black-body radiation corresponding to the change of temperature of the air near the instrument was on the average 0·47, but the ratio was smaller at lower levels than at higher. The results are discussed with reference to Ångström's formula for atmospheric radiation. AUTHOR.

5062. Thunderstorm Researches. Relation between Sources of Atmospherics and Meteorological Conditions in Southern Australia during October and November, 1934. R. W. Boswell and W. J. Wark. *Roy. Meteorolog. Soc., J.* 62. *pp.* 499–527, *Oct.*, 1936.—In the paper the authors provide a historical survey of the association of atmospherics, fronts and thunderstorms. A description is given of the apparatus used and the meteorological data available for S. Australia, no atmospheric sources being used which lasted for under 3 hours. In the *Discussion*, **Laby** dealt with the structure of the discharge and its relation to the wave-form of the pulses making up the atmospheric, the structure of thunderstorms, the wave-form and source of atmospherics, and the meteorological conditions associated with the different types of thunderstorms; **Douglas** discussed several examples of the meteorological conditions associated with thunderstorms; **Watson Watt** described radio methods used to locate atmospherics; **Shipley** referred to the phenomena observed in various countries; and **Scrase** described the electric field near thunderstorms and instability showers. R. S. R.

5063. Regularities in Wind Distribution. T. Hesselberg. *Geofysiske Publ.* 11. 9. *pp.* 3–21, 1936. *In German.*—From the wind registrations at Ås the direction and velocity were extracted for each hour for Jan. and Oct., 1929, and tabulated for the scale 01–32 for wind direction and in units of 0·7 m./sec. for speed. Mean and mean-square values are obtained and the empirical and Maxwellian distributions found. The frequency of the wind in selected directions and its mean velocity are calculated together with the deviations from the mean. Values are also tabulated and shown in graphs for the mean period of the wind change. R. S. R.

5064. Atmospheric Soundings by Luminous Rays. J. P. E. Duclaux. *J. de Physique et le Radium*, 7. *pp.* 361–364, *Sept.*, 1936.—From a point on the ground a luminous beam is projected slightly inclined to the horizontal and with minimum divergence. The beam is photographed simultaneously from several points on the ground several km.

apart along the beam. From the photographs, by calculation of the refraction, the temperature and pressure of the air are obtained. One can also measure the diffusion as a function of height and so recognise the superposition of air masses of different origin. A first experimental study shows no serious difficulties are encountered even when the atmosphere has nearly its maximum transparency. R. S. R.

5065. Lunar Atmospheric Tide at Melbourne. S. Chapman, M. Hardman and J. C. P. Miller. *Roy. Meteorolog. Soc., J.* 62. *pp.* 540–551, *Oct.,* 1936.—The lunar atmospheric tide at Melbourne, Australia, has been determined from nearly 36 years' record; the mean result is 28 sin $(2t + 84\cdot0^\circ)$ microbars, with a probable error of 2·3 microbars. This is compared with the determination made by Neumayer from data for the years 1858–63: his result is found to be affected by so large a probable error as to be practically without value. The Melbourne tide is affected by a seasonal variation, of normal type as regards phase (high tide occurring later in Dec. than in June), but abnormal in that the amplitude is greatest in Dec. The solar daily variation at Melbourne is also analysed, as determined from all or almost all days, and separately from 421 days of barometric disturbance; the latter show the expected "concave variation," the complement of Bartels' "convex variation" characteristic of barometrically "quiet" days. AUTHORS.

5066. Apparent Colour of Lights at Night; With an Observation of "Blue Fog." W. E. K. Middleton. *Roy. Meteorolog. Soc., J.* 62. *pp.* 473–480, *Oct.,* 1936.—On the basis of the C.I.E. (1931) colour metric an expression is developed for the colour coordinates and luminosity of a given light source seen at night through an atmosphere of known optical properties. This is applied to an observation on a mercury-vapour lamp in a highly selective haze of the type sometimes called "blue fog." AUTHOR.

5067. Secular Variation of Rainfall at Adelaide. E. A. Cornish. *Roy. Meteorolog. Soc., J.* 62. *pp.* 481–492, *Oct.,* 1936.—A detailed analysis of the rainfall at Adelaide, S. Australia, for the period 1839–1933 has been made according to Fisher's recent methods using a series of orthogonal polynomial functions of the 5th degree. A definite oscillation is traced in the incidence and duration of the winter rains with a period and amplitude of approximately 23 years and 30 days respectively. The amplitude, though small, is nevertheless about 20 % of the length of the rainfall season. The total quantity precipitated has shown no statistically significant changes. In reply to the *Discussion,* **Fisher** justified the use of the mathematical methods employed for this investigation. R. S. R.

5068. Analysis of Variation by the Use of Orthogonal Polynomials. F. J. W. Whipple. *Roy. Meteorolog. Soc., J.* 62. *pp.* 492–498, *Oct.,* 1936.—In an analysis of the mathematical methods used by Cornish [see preceding Abstract] it is considered that better results would be obtained by harmonic analysis and that the distortion at the ends of the range which occur when using the approximation by polynomials would be avoided. It is shown that the oscillation of 23 years discovered by Cornish agrees with the variation in sunspot numbers. For the period of the Adelaide rainfall record the rainy season tends to get earlier year by year during the cycle when the magnetic field round the leading sunspot of a pair is such as would be produced by the cyclonic movement of positive electricity round the spot and to get later year by year when the magnetic field of the leading sunspot is reversed. R. S. R.

5069. Photoluminescence Phenomenon in the Upper Atmosphere; Excitation of Oxygen by the Solar Ray 6300 Å. J. Cabannes and H. Garrigue. *Comptes Rendus*, 203. *pp.* 484–487, *Aug.* 31, 1936.—Values are obtained for the intensity of the ray 6300 Å and the depression of the sun after twilight, and a curve obtained for the luminescence of successive layers as a function of the altitude. Two possible explanations for the mechanism producing the luminescence are discussed, one involving a resonant radiation with the atom in a metastable state and the other a decomposition of the O_3 molecule to O_2 with the release of energy by the ray 2680 Å. The results obtained cannot be explained by the action of the solar ray alone. [See Abstract 3565 (1936).] R. S. R.

5070. Illumination of the Atmosphere. P. Gruner. *Helv. Phys. Acta*, 9. 7. *pp.* 596–601, 1936. *In German.*—Various formulæ for the illumination of the atmosphere by the sun have been developed which break down either at very high or at very low values of the zenith angle. An attempt is now made to deduce a formula valid at all angles. C. B. A.

***5071. Compensated Mercury Barometers. J. Hartmann.** *Journ. Sci. Instruments*, 13. *pp.* 323–330, *Oct.*, 1936.—It is shown that barometers can be designed so that for a given pressure the position of the lower surface is independent of the temperature. Measurement of another neighbouring pressure is then reduced to a simple difference measurement only requiring temperature correction for the difference from the pressure for which the barometer is "compensated." Designs for such barometers are given, including a syphon barometer and a portable barometer. AUTHOR.

See also Abstracts 5075, 5103, 5107, 5198.

SEISMOLOGY.

5072. Solution of a Double Integral in the Determination of Epicentral Depth. F. Conforto and T. Viola. *Ricerca Scientifica*, 2. *pp.* 161–198, *Aug.*, 1936.—Mathematical. W. A. R.

5073. Earthquake Investigations in California, 1934–1935. *Coast and Geodetic Survey, Special Publ. No.* 201. [231 *pp.*], 1936.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

5074. Photographic Study of Lightning. E. J. Workman, J. W. Beams and L. B. Snoddy. *Physics*, 7. *pp.* 375–379, *Oct.*, 1936.—Photographs of lightning taken with rotating film cameras near Albuquerque, New Mexico, in the summer of 1935 show three different types of electrical breakdown. In the first type the first flash starts at the cloud, proceeds about 1 km. and stops abruptly in air. This was followed in 0·008 sec. by a second flash traversing the same path but extending it about 0·22 km. The third similar flash 0·01 sec. later extended the path 0·5 km. The fourth flash extended the path clear to earth 0·0098 sec. later. The second type showed the well-known "leader" type of breakdown of Schonland and others. The third type of breakdown consisted of only the main violent discharge between cloud and earth. The results are briefly discussed and a new possible mechanism for lightning breakdown pointed out. AUTHORS.

5075. Atmospheric Potential Gradient Anomalies. F. L. Cooper. *Physics,* 7. *pp.* 387–394, *Oct.,* 1936.—A series of observations of the atmospheric potential gradient have been made over a period of 6 years and have been correlated with positions of the sunspots and weather conditions. Maxima or minima of the potential gradient and storms appear to recur at intervals of approximately 27 days and at the same time that sunspots appear near a plane through the axis of the sun and the earth. The supposition is made that the variations of the potential gradient and the storms are associated with radiation which travels approximately with the velocity of light from the sun. Since the light received from the sunspot group cannot change rapidly as the group passes its position of nearest approach to the earth it seems more reasonable to suppose that a radiation not distributed according to Lambert's cosine law is involved. AUTHOR.

5076. Diurnal Variations of Terrestrial Magnetism on Quiet Days. M. Hasegawa. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 185–188, *July,* 1936. *In English.*—The materials are taken from observations at Aso from Aug., 1932 to Aug., 1934, and at Kakioka during 1931. Four types mentioned are P, E [see Abstract 3577 (1936)] and two intermediate types P^1, E^1. The comparisons made are between the P and E types. Seasonal changes of the times of occurrence of various maxima and minima in the monthly means of the hourly values of H and D were observed; a change in H accompanies sunrise, and a change in D accompanies the sunset. In a harmonic analysis of the changes of H, the relative magnitudes of the first and second terms differ with the types, and they are reversed in summer and winter. Recurrence of the type was also studied. A difference is found between the two types for the excess of the sunspot number; and the number of days on which the international character numbers are zero, or 0·01, is somewhat greater for days of P type than for those of E type from June to Dec., and smaller in the other half year. G. E. A.

See also Abstract 5062.

RADIOACTIVITY.

5077. Distribution of Radium and its Isotopes in the Crystallisation of Barium Chlorate. B. Goldschmidt. *Comptes Rendus*, 203. *pp.* 617–618, *Oct.*, 5 1936.—The possibility that the distribution of the radioactive isotope between crystals formed from a saturated solution of $BaClO_3$ to which the radioactive isotope is added and the remaining solution might vary according to the isotope is examined by crystallising $BaClO_3$ from solutions to which Ra ($^{226}_{88}Ra$), ActX ($^{223}_{88}Ra$) and ThX ($^{224}_{88}Ra$), are added separately, and by determining the activities of the products. No differences greater than errors of experiment are found.
C. A. S.

5078. Collisions of α-Particles with Sulphur Nuclei. R. L. Anthony. *Phys. Rev.* 50. *pp.* 726–732, *Oct.* 15, 1936.—More than 700,000 Th C and C′ α-particle tracks have been photographed with a stereoscopic camera in a Wilson chamber filled with a mixture of H_2S and H_2. A range-velocity curve for S recoil atoms is constructed by plotting the measured ranges (reduced to standard air) against the calculated velocities for 60 selected α-particle S collisions. This curve is discussed and compared with the results of other workers. A possible relationship is noted between the range-velocity curves of atoms having similar electronic configurations. No collisions indicating possible S disintegrations are observed. Several low energy collisions are noted which are appearently lacking in coplanarity, but this effect is explained as being due to small deflections suffered by the recoil nucleus shortly after the collision. The calculated distances of closest approach are compared with the radius of the S nucleus as given by Pollard and Brasefield. The methods of measurement and calculation employed are checked by applying them to collisions with protons.
AUTHOR.

5079. Theory of β-Decay. A. Ter-Pogossian. *Phys. Zeits. d. Sowjetunion*, 10. 1. *pp.* 115–116, 1936. *In English.*—A modification of Fermi's theory of the β-decay is proposed which contains a second derivative of the wave function of the neutrino and the first derivative of the wave function of the electron. It is claimed that this modification leads to an energy distribution in the β-spectrum which is in good agreement with the experiments and that it leads to a neutron-proton force of the right order of magnitude. It is further stated, without proof, that this theory, and similarly that of Fermi, would lead to a repulsive, rather than an attractive force between neutron and proton.
R. P.

5080. β-Ray Spectra of Radioactive Manganese, Arsenic and Indium. M. V. Brown and A. C. G. Mitchell. *Phys. Rev.* 50. *pp.* 593–598, *Oct.* 1, 1936.—The β-ray spectra of radioactive Mn, As and In are obtained by measuring tracks produced in a cloud chamber situated in a magnetic field. Mn and As give spectra which can be resolved into two components. The endpoints of the two components are: for Mn, 1·2 and 2·9 eMV; for As, 1·09 and 3·4 eMV. The endpoint for In is 1·45 eMV.
AUTHORS.

5081. Primary Ionisation of High Energy Electrons in Nitrogen and Neon. H. K. Skramstad and D. H. Loughridge. *Phys. Rev.* 50. *pp.* 677–681, *Oct.* 15, 1936.—A large expansion chamber in a magnetic field of about 400 gauss is used to study the tracks of high energy β-rays produced by bombarding a lead screen inside the chamber by Rn γ-rays. Two photographs at right angles are taken, and the tracks examined by projection on to a screen in their original configuration. Measurements are made of the number of primary ions per cm. of path produced in N_2 and Ne. The results in N_2 can be expressed approximately by the relation : $I = 19\beta^{-1\cdot15\pm0\cdot15}$, and in Ne by the relation : $I = 12\cdot6\beta^{-1\cdot35\pm0\cdot15}$, where I is the primary ionisation in ions per cm. at normal temperature and pressure, and β is the velocity of the β-ray in units of the velocity of light. Measurements on a few tracks in O_2 agree within experimental error with the results of Williams and Terroux. The primary ionisation of the positive electrons observed is indistinguishable from the negative electrons. Comparisons are made with the theoretical calculations of Bethe, Moller, and Williams, and the agreement is satisfactory over the range of velocities used. The magnitude obtained for the primary ionisation in N_2 corresponds on the basis of the formula obtained by H-like wave functions, to an average ionisation potential of 16·6 V for the five outer electrons in the N atom, which is very near its minimum ionisation potential. Theoretical calculations are made for Ne, using ionisation potentials for each electron calculated from critical absorption wave-lengths. The experimental results are somewhat greater than those calculated from the theory, but are as close as the somewhat arbitrary assumptions involved would allow one to expect. The variation of primary ionisation with velocity checks well for values of less than 0·97, but the predicted increase for very high energies is not observed. AUTHORS.

5082. γ-Rays of Lithium and Fluorine under α-Particle Bombardment. K. C. Speh. *Phys. Rev.* 50. *pp.* 689–694, *Oct.* 15, 1936.—The energies of the γ-rays emitted from Li and F under bombardment by Po α-particles are determined, and their variation with the energy of the incident particles is studied. In the case of Li no change in γ-ray energy is observed as the range of the incident α-particles is reduced from 3·9 cm. to 2·5 cm. This is taken to support the view that the radiation results from excitation of the Li nucleus without capture of the α-particle. At an incident range of 3·9 cm. the γ-radiation from F is shown to consist of two components. When the incident range is reduced to 3·1 cm. the harder component disappears. Possible explanations are discussed, and the existence of a hitherto undetected proton group of low energy is suggested. AUTHOR.

5083. Quantitative Interpretation of the Scattering of γ-Rays by Lead. E. Stahel, H. Ketelaar and P. Kipfer. *J. de Physique et le Radium*, 7. *pp.* 379–388, *Sept.*, 1936.—It is known that if the γ-rays of RaC are scattered by lead, the scattered radiation contains a strong component of about 0·9 MV. This component can be accounted for as impact radiation produced in the collision between Compton- and photoelectrons with Pb atoms. As no formula is available for the rate of production of such impact radiation, measurements of the production of secondary γ-rays by the β-rays of UX were used. In this way one can estimate the intensity of scattered radiation of high energy and the result agrees with the observed results. On the other hand it is shown that the hard γ-rays which are produced in the annihilation of positrons that were created by the incident radiation, would account for only a few % of the observed figure. R. P.

5084. Coherent Scattering of γ-Rays. E. Stahel and H. Ketelaar. *J. de Physique et le Radium,* 7. *pp.* 389–390, *Sept.,* 1936.—The absorption curve of the radiation scattered through 120° by Pb from the γ-rays of RaC has been measured. It indicates the presence of a component with unmodified wave-length. The intensity of this component is about 4·5 % of that of the component at 0·9 MV. A theoretical formula of Franz for the intensity of scattering without change in wave-length could account for about 1/5 of the observed intensity. It is suggested that the rest is radiation, the energy of which is slightly less than that of the incident radiation and which may be due to impact radiation from fast Compton electrons or photoelectrons. R. P.

5085. Photographic Action of Radium γ-Rays. G. E. Bell. *Brit. J. of Radiology,* 9. *pp.* 688–692, *Oct.,* 1936.—This paper describes the results of a research into the photographic action of Ra γ-rays. It is shown that their action is analogous to that of X-rays, and that up to densities of about unity the photographic density is nearly proportional to the exposure. The validity of the Bunsen-Roscoe reciprocity law is established over an intensity range of 100 to 1. [See also Abstract 4760 (1936).] AUTHOR.

***5086. Difference between Counting H-Rays by an Electrical and by a Visual Method. A. Wagner and G. Kirsch.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 3–4. *pp.* 175–194, 1936.—Between the two methods of counting H-rays, namely electrical recording with the valve electrometer and direct counting by visual observations of the scintillations, a considerable difference, amounting to some 50–70 %, is generally obtained. In attempting to explain this difference the author shows firstly, by observations with two counting chambers of the radiation before and after passage through the zinc sulphide screen, that it cannot be due to a true radiation. The varying results obtained by using different observers and an apparatus, which is fully described, point to the effect being physiological and psychological. The weakness of the H-scintillations as compared with α-particle scintillations, which has been investigated by Kara-Michailova and Karlik [see Abstract 1097 (1930)] is shown to be an important factor in the excess obtained by the scintillation method. In an Appendix, **G. Kirsch** considers the effect, on the counting of the rays, of the blindness to scintillations of part of the retina. With a small field of vision, this factor is not negligible. G. O. B.

***5087. Measurements on Single Corpuscular Rays in the Presence of Intense γ-Rays. H. Pose.** *Zeits. f. Physik,* 102. 5–6. *pp.* 379–407, 1936.—The duant electrometer, the valve electrometer and the tube counter are examined experimentally and theoretically concerning their ability to distinguish single corpuscular rays in the presence of statistical fluctuations caused by intense γ-rays. F. C. C.

5088. Ionisation Method for the Absolute Measurement of γ-Ray Energy. L. H. Gray. *Roy. Soc., Proc.* 156*A*. *pp.* 578–596, *Sept.* 1, 1936.—On the basis of certain assumptions it may be shown that the γ-ray energy absorbed in any medium is related to the ionisation produced in a gas-filled cavity in that medium in the following manner: $E_v = J_v W \rho$, where E_v is the γ-ray energy absorbed per unit volume of the medium, J_v is the ionisation per unit volume produced in the gas, W is the average energy lost by the secondary electrons per pair of ions formed in the gas, ρ is the ratio of the stopping power of the medium and the gas for the secondary electrons. This relation is examined critically from the experimental standpoint, and a number of implications are shown to be supported by experiment. From a consideration of the experimental results of White and Millington and of the Bethe-Williams theory of β-ray stopping power, it appears that ρ is practically constant over a very wide range of electron energies, and that the variation of ρ with atomic number, as given by the Bethe-Williams theory, leads to values of the ionisations in chambers made of different elements which are in very satisfactory agreement with experiment. It is concluded that the value of W for air is almost certainly between 32 and 33 volts per ion pair. The relation is applied to the absolute determination of γ-ray and neutron energy. AUTHOR.

5089. Measurement of Radium and Radon Solutions. Dora Buchgraber. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 3–4. *pp*. 261–267, 1936.—The difficulties involved in precision measurements of the ionisation produced by small quantities of Rn of the order of 10^{-9} Curie, are discussed. A method of investigation of the problem of saturation is described. It is shown that the contribution of the emanation in equilibrium with its decay products to the total ionisation is 50 %. A formula for such estimations is developed. J. E. R.

***5090. Testing and Measurement of Radium Containers. W. E. Perry.** *Brit. J. of Radiology*, 9. *pp*. 648–658, *Oct.*, 1936.—A description is given of the apparatus and methods used at the National Physical Laboratory for testing Ra containers for leakage of Rn, uniformity of distribution of the radioactive material, and Ra content. Reference is made to the corrections which are required to obtain the " actual " or true Ra content from the " effective " or observed content. AUTHOR.

***5091. Forceps for Handling Radioactive Substances. L. F. Curtiss.** *Rev. Sci. Instruments*, 7. *pp*. 393–394, *Oct.*, 1936.—The forceps are designed to enable Ra containers to be manipulated while the hands are at least 20 cm. from it, and the construction is of light metal, to reduce weight and also to reduce secondary radiation. The jaws of the forceps are of the conventional design, but in place of the usual arms, one jaw is bonded firmly to an Al tube and the other pivotted to an Al rod passing through the tube. In use the rod is pushed by means of a trigger at the remote end, so that the jaws are opened. On release of the trigger the jaws are closed by a spring. G. E. B.

5092. Effect on Various Glasses of Irradiation with Radon. Johanna Wiesthal. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 3–4. *pp*. 239–260, 1936.—Bulbs of seven different varieties of glass were first boiled out with water. Each was then similarly boiled out with a smaller sealed bulb containing Rn enclosed therein, the conductivity (indicating amount dissolved) being determined in both cases at fixed intervals and plotted against time. The amount dissolved was also checked colorimetrically. The radiation from the Rn increased the amount dissolved, the action increasing parabolically with the amount of Rn, and also continuing slightly after its removal. The nature of the dissolved material was determined spectroscopically, the amount being approximately in the order Si, B, Al, Na, Ca, Ba, Mg, but somewhat dependent on the composition of the glass. The quality of a glass as regards resistance to boiling water decreases with increasing alkali content. With the radiation the specific structure of the glass (consisting of oxides of Si, B and Al) is attacked, especially the Al_2O_3. The results favour Zachariasen's theory of the structure of glass. [See Abstract 30 (1933).] C. A. S.

See also **Abstracts 4938, 5109, 5185, 5237, 5238.**

RADIATION.

ABSORPTION AND TRANSMISSION.

***5093. Effect of Temperature on the Absorption of Filters. K. Weber.** *Zeits. f. wiss. Phot.* 35. *pp.* 193–196, *Aug.*, 1936.—The effect of temperature change is to shift the absorption bands of a filter, the shift becoming of practical importance when a combination of filters is employed to isolate a narrow spectral band. Thus, the total transmission of a 2 mm. Schott R.G.2 glass filter combined with 35 mm. of 1 % $CuSO_4$ solution (transmitting only 600–650 mμ) falls linearly with temperature increasing from 10° to 40° C., the slope being 0·5 % per degree. L. V. C.

5094. Alkali Metal Films Transparent in the Schumann Region. W. H. Watson and D. G. Hurst. *Canad. J. of Research*, 14. *Sect. A. pp.* 153–157, *Aug.*, 1936.—Na and K films deposited from a molecular beam on fluorite at liquid-air temperature have been found to be transparent in the Schumann region. For $\lambda > 1400$ Å no transparency has been found in the case of Li. A technique for producing these films is described. The theoretical bearing of these results is discussed. AUTHORS.

See also Abstracts 4983, 5112, 5225.

COLORIMETRY.

***5095. Photoelectric Colorimeter. F. M. Turrell and L. Waldbauer.** *Iowa Acad. Sci., Proc.* 42. *pp.* 63–70, 1935.—A simple photoelectric colorimeter is described and experimental data are given which indicate the suitability of certain types of electrical current for operating the photoelectric colorimeter. Data are presented for $KMnO_4$, $NiSO_4 \cdot 6H_2O$ and chlorophyll $(a + b)$ solutions. A Bibliography on photoelectric colorimeters is given. AUTHORS.

See also Abstract 5066.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

5096. Optical Investigation of Liquid Helium II. L. W. Schubnikow and A. K. Kikoin. *Phys. Zeits. d. Sowjetunion*, 10. 1. *pp.* 119–120, 1936. *In German.*—The optical properties of HeII are very briefly stated. When the liquid is cooled from 4·22° to 1·72° Abs., no rotation of the plane of polarisation can be detected. In an investigation of the Kerr effect at 1·72° Abs. and with a constant field of 6300 V/cm. no change in intensity could be detected between crossed nicols. It is concluded that the anisotropy of liquid He is less than the accuracy of measurement, and the anomaly of the specific heat cannot be explained on the theory of liquid crystals. E. H. D.

5097. Magneto- and Electro-Optical Properties of Para-Azoxyanisol. Jacqueline Z.-K. Eisenmann. *Ann. de Physique*, 6. *pp.* 455–502, *Oct.*, 1936.—Measurement of the magnetic birefringence of isotropic molten para-azoxyanisol proves that the mutual actions between the molecules, which determine their tendency to orientate parallel in the nematic phase, still persist in the isotropic phase over a range of temperature of several degrees above the transition point. It is suggested that this effect might also occur in ordinary substances above their melting points, giving rise to a crystalline structure in the liquids such as has been observed by Debye by X-ray methods. C. B. A.

5098. Magnetic Birefringence in Solutions of Organic Substances. L. D. Mahajan. *Phil. Mag.* 22. *pp.* 717–725, *Oct.*, 1936.—The magnetic birefringences of 21 derivatives of benzene, diphenyl or cyclohexane in various solvents are recorded and discussed. C. B. A.

5099. Magneto-Rotatory Dispersion of D_2O in the Ultra-Violet. A. Hagenbach. *Helv. Phys. Acta*, 9. 7. *pp.* 582–586, 1936. *In German.*—The magneto-rotatory dispersion of D_2O is compared with that of H_2O over the range 5461 to 2655 Å. The Verdet constants of D_2O are about 4 % lower than those of H_2O and the divergence increases with decreasing wave-length. C. B. A.

5100. Magnetic Rotation of Lanthanum and Neodymium Chlorides in Aqueous Solution. C. M. Mason, R. D. Gray and Grace L. Ernst. *Am. Chem. Soc., J.* 58. *pp.* 1600–1604, *Sept.*, 1936.—The magnetic rotations of aqueous solutions of Al, La and Nd chlorides have been measured from 10 to 50° at wave-lengths 5893 and 5460·8 Å. The Verdet constants of these solutions have been calculated and those for $NdCl_3$ solutions found to vary linearly with $1/T$. The molecular rotations of the $NdCl_3$ solutions have been calculated and found to vary with temperature according to the equation $(T - 32{\cdot}6)D = -790{\cdot}1$. The variations of the Verdet constants with temperature were found to agree qualitatively with the predictions of Serber. AUTHORS.

See also Abstracts **5113**, **5254**.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

5101. Luminescence and Colouring by Becquerel Rays. Part IV. K. Przibram. *Zeits. f. Physik*, 102. 5–6. *pp.* 331–352, 1936.—A continuation of previous work [see Abstract **2329** (1931)]. The number of colour centres per quant has been variously estimated, *e.g.*, for α- and β-rays by absorption methods, at 1000 and 100, while Burbidge from the photoelectric saturation current gets one in each case. Burbidge's results are criticised. The effect of pressure on the colouring of alkali halides by radioactive radiations and of blue light on this colouring is discussed. These effects are considered not to be restricted to the crystalline state. The author compares naturally coloured rock-salt with artificially coloured salt and discusses the possible sources of colouring radiations. The relation is discussed between deepness of colouring and rate of growth of different faces of salt crystals. In general it appears—and experiments on artificial crystals confirm this—that the faster the growth the faster the colouring and decolouring. The colouring of fluorite is again considered due to radioactive radiations. Comparison of absorption spectra of natural fluorite with that of fluorite coloured by introduction of electrons at high temperature (Mollwo) shows that the absorption peaks are the same, but a comparison of different zones of a natural crystal shows that Mollwo's violet band occurs only in one zone and his green band only faintly in another zone. A comparison of different fluorites and of different zones in the same fluorite as regards absorption, fluorescence, colouring by radiation and effect of light is given. Many fluorites show after radiation from Ra a red fluorescence band as well as the previous blue band. It is considered that the blue band so common with fluorites is also due to radioactive radiations, possibly from included U. Synthetic preparations of CaF_2 made by Rona have shown that the blue band is associated with the presence of Eu and the green band with Yb. The red band is unaccounted for. Finally it appears that it is precisely those rare earths which form divalent salts that are activators of fluorescence. The fluorescence spectrum of pure $EuCl_2$ is very similar to that of Eu activated CaF_2. J. E.

5102. Decay of Phosphorescence in Boric Acid and Aluminium Sulphate Phosphorescent Substances. W. L. Lewschin and L. A. Vinokurov. *Phys. Zeits. d. Sowjetunion,* 10. 1. *pp.* 10–33, 1936. *In English.*—An exponential law governing the decay of phosphorescence has been established for a series of phosphors prepared from boric acid and from $Al_2(SO_4)_3 + 18H_2O$ and activated by various organic dyes. Increase in concentration of the dye shortens the mean life of the excited state and diminishes the intial intensity. These phosphors also exhibit bright fluorescence, and the relative intensities of phosphorescence and fluorescence are independent of the concentration of the activator. The luminescence efficiency of the phosphors when activated by dyes of the fluorescein series varies in the same sequence as for liquid solutions of the dyes. The phosphorescences exhibited by the boric acid phosphors and solid solutions have a similar character, which is different from that of crystalline substances activated by heavy metals. The effect of quenching processes on initial intensity and efficiency of luminescence is discussed, and it is suggested that the concentration quenching of boric acid phosphors is largely due to the formation of non-luminescent molecules of the activator. C. B. A.

5103. Afterglow of Active Nitrogen. G. Cario and U. Stille. *Zeits. f. Physik,* 102. 5–6. *pp.* 317–330, 1936.—A number of theoretical and experimental reasons are given for doubting the reality of Kaplan's production in the nitrogen afterglow of the N_2^+ first negative system and those bands of the N_2 first positive system originating on vibrational levels $v' > 14$ [see Abstract 2845 (1934)]. It is suggested that his results were due to an accidental superposition of the spectrum of the exciting discharge on that of the afterglow. The effect of pressure on the production and relative intensities of the first and second positive and Vegard-Kaplan bands of N_2, and of the β and γ bands of NO in the afterglow is discussed in the light of the Cario-Kaplan theory. The importance of the part played by the walls of the containing vessel in affecting collision processes in the afterglow is emphasised. The excitation of auroral and night-sky spectra is briefly discussed. A. Hu.

5104. Energy of Metastable Nitrogen Molecules. H. Hamada. *Tohoku Univ., Sci. Reports,* 25. *pp.* 217–226, *July,* 1936. *In English.*—The results of (1), the intensity distribution of the bands attributing to the metastable nitrogen molecule, (2) the metallic spectra excited by the metastable nitrogen molecule, and (3) the intensity of the bands in the afterglow of active nitrogen are reported. It is ascertained that in the active nitrogen the concentration of the metastable molecule with the lower vibrational quantum numbers and especially those in the non-vibrational state is negligibly small in comparison with that in the ordinary discharge tube. The nature of active nitrogen is also discussed. AUTHOR.

5105. Luminescence of Solids in Geissler Tubes, M. Servigne. *Comptes Rendus,* 203. *pp.* 581–583, *Sept.* 28, 1936.—The difference in the susceptibility of various substances (*e.g.,* calcium phosphate) to excitation to luminescence by electron bombardment and u.v. light is used to investigate the mechanism of excitation of thin layers of solids on the walls of Geissler tubes containing Ne or A with Hg. At a pressure of a few mm., the emission is characteristic of photoluminescence, at about 1/100 mm. of kathodoluminescence. If the luminescent solid is protected from the electrons of the discharge by admixture with silica, the emission is unaltered. Hence the excitation is chiefly due to u.v. light. H. G. C.

See also Abstracts 5069, 5093, 5139.

INTERFERENCE. DIFFRACTION AND SCATTERING.

5106. Interference at Water Surfaces. J. Baurand. *J. de Physique et le Radium*, 7. *pp*. 365–370, *Sept*., 1936.—Two methods for the observation of interference at the surface of a liquid are considered. One is a variant of the Foucault method while in the other the points of the surface giving the image on the screen are sought. It is shown that for an illuminated screen, the image includes not only the hyperbolic ventrals (maximum amplitude) but also the hyperbolic nodes. These are sharp when the lines of the source are seen from a distance but enlarge when the lines approach nearer. The necessary conditions for the measurement of surface tension of the liquid by this method, using Kelvin's formula, are described. R. S. R.

See also Abstracts 4954, 5218, 5219, 5220, 5221, 5222, 5223.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

5107. Effect of Temperature on the Photosynthesis of Ozone. A. Eucken and F. Patat. *Zeits. f. phys. Chem*. 33. *Abt.B*. 6. *pp*. 459–474, 1936.—The authors examine the mechanism of the photochemical production of O_3 when pure O_2 is irradiated with u.v. light (1720 Å) from an Al spark. The scheme advanced is: (1) $O_2 + h\nu = 2O$; (2) $O + O_2 + M = O_3 + M \ldots k_2$; (3) $O_3 + O = 2O_2 \ldots k_3$; M being an O_2 molecule catalysing the reaction by making a triple collision possible. It is shown that this process should lead to the attainment of an equilibrium O_3 concentration $[O_3] = (k_2/k_3)[O_2]^2$ which is independent of the light intensity. This is verified, and k_2/k_3 is shown to be independent of the pressure, whilst $\log(k_2/k_3) \propto 1/T$. Reasons are advanced to account for an absolute value of k_2/k_3 some three times smaller than that obtained by Schumacher and Beretta from experiments on photochemical decomposition [see Abstract 4673 (1932)]. From the variation of k_2/k_3 with T, the heat of the reaction (3) above is put at 6160 ± 100 cal./mol., a value in agreement with Schumacher's. The bearing of the results on O_3 formation in the stratosphere is briefly discussed. A. Hu.

5108. Degree of Sensitivity and Practical Photography. R. Mauge. *Soc. Franç. Phot. et Ciné., Bull*. 23. *pp*. 161–171, *July*, 1936.—Suggests a new method of indicating sensitivity which does not depend on laboratory sensitometric measurements and which is better commercially than the systems at present in use. The figure is arrived at by obtaining the minimum time necessary to give an excellent photograph, in full sun on a clear day, of an open country scene, without heavy foreground, using an *f*.10 stop, the reciprocal of this time being taken as the degree of sensitivity. R. C. F.

5109. Temperature-Coefficient of Photographic Sensitivity. Part II. Effect of Low Temperature on Photographic Action of α-Particles. S. E. Sheppard, T. R. Wilkins, E. P. Wightman and R. N. Wolfe. *Kodak Research Lab. Comm. No.* 590. *Frank. Inst., J.* **222.** *pp.* **417–460,** *Oct.,* **1936.**—The Kinoshita exponential equation relating density of developed film to exposure to α-rays does not apply for a diffuse source of the α-radiation for either a process or double-coated panchromatic emulsion, but two somewhat similar expressions have been deduced which fit experimental results. The action of α-rays on such emulsions at − 185°, − 80° and + 20° has been compared. The relative effect on the two varieties of emulsion of α-rays at 20° is much the same as of light. When exposure is at − 185° there is loss of contrast similar to that found with light (not attributable to reciprocity law failure), but less loss in speed. The rate of development is (at least at first) less for exposure at low temperature. The hypothesis based on results with light, that loss in contrast and speed with low temperature exposure, is, at least partially, caused by immobility and non-absorption at the time of exposure of Br set free by exposure appears to hold for exposure to α-rays. [For Part I see Abstract 4161 (1934).] C. A. S.

***5110. Semi-Automatic Apparatus for the Development of Sensitometer Strips. S. E. Sheppard, R. H. Lambert and G. Atkins.** *Phot. Indust.* **34.** *pp.* **988–992,** *Sept.* **9, 1936.**—Standardised flow of developer over sensitometer strips in a thermostatic developing dish is obtained by passing a roller at a fixed clearance over the strips. The roller is driven with a reciprocating motion by an air-motor of the screen-wiper type. The developed density becomes more uniform and steeply increases as the clearance between roller and plate is reduced and also increases to a maximum as the frequency of reciprocation is increased, but the fog-density is unaffected. A standardised clearance (0·0625 in.) and frequency (80/min.) permit, in one example, a density uniformity of 0·97 ± 0·02 over a 20 × 22·5 cm. plate. L. V. C.

See also Abstracts 5115, 5157, 5202, 5290.

PHOTOMETRY.

***5111. Recording Spectrophotometer. J. L. Michaelson and H. A. Liebhafsky.** *Gen. El. Rev.* **39.** *pp.* **445–450,** *Sept.,* **1936.**—Describes the industrial form of Hardy's new recording spectrophotometer [see Abstract 4217 (1935)] and gives details of its performance when applied to certain particular problems in colorimetric measurement. The special applications described are the study of the permanence of organic finishes, the determination of the effect of altering thickness in enamel coatings and various special kinds of chemical analysis, *e.g.*, the determination of titanium either unaccompanied or in the presence of iron, and the identification of certain elements. J. W. T. W.

***5112. Photoelectric Spectrometer of High Accuracy. J. S. Preston and F. W. Cuckow.** *Phys. Soc., Proc.* **48.** *pp.* **869–880,** *Nov.* **1, 1936.**—Details are given concerning the components used in constructing a photoelectric spectrophotometer employing as light-sensitive element a vacuum emission photo-cell of a modern type with central plate kathode It is claimed that the instrument as a whole has a linear response over the necessary range of photo-currents and the method by which this property was tested is described. The instrument has been applied to the measurement of spectral transmissions of the International Standard

Blue Filter R 3·28, and the results, which are in good agreement with the internationally adopted figures, are given in full. The effect of temperature on this filter is shown also. AUTHORS.

See also Abstracts 5114, 5171.

POLARISATION.

5113. Optical Rotatory Power of Solutions in an Electric Field. J. Kunz and S. H. Babcock. *Phil. Mag.* 22. *pp.* 616–624, *Oct.*, 1936.—Various optically active menthyl compounds have been subjected to an electric field. No Kerr effect has been observed, but the rotation of the plane of polarisation depends on the angle between that plane and the lines of the external electric field. The rotation of the plane of polarisation is a function of the field strength quite different from the Kerr effect. AUTHORS.

***5114. Prism Spectrographs and Spectrophotometry of Plane Polarised Light. Part II. G. Bolla.** *N. Cimento,* 13. *pp.* 241–283, *June,* 1936.—The author extends the considerations of his previous paper [see Abstract 4153 (1936)] to the case of spectrographs employing prisms and lenses of quartz. These present additional difficulty due to the rotation of the plane of polarisation of the light by the quartz. The precautions and special artifices necessary to obtain reliable spectrophotometric determinations are studied and shown to be very restrictive. W. S. S.

***5115. Polarisation of Light and Some Technical Applications. A. F. C. Pollard.** *Nature,* 138. *pp.* 311-314, *Aug.* 22, 1936.—An account is given of Land's invention of Polaroid, a polarising material in sheet form. The methods of manufacture and some of the principal properties of the material are described. Among the applications of the material are enumerated the elimination of glare from motor car headlights, suppression of specular reflections in photography and other photographic uses, stereoscopic cinema projection, stage lighting effects, and the replacement of Nicols in strain viewers and other instruments where complete polarisation is not necessary. The work of Weigert and others on the transformation of certain isotropic colloidal systems into systems with double refracting and dichroic properties following exposure to plane polarised light is briefly outlined. [See also Abstract 4673 (1936).] W. S. S.

See also Abstracts 5096, 5167, 5168.

RADIATION, EMISSION.

***5116. Limiting Sensitivity of a Radiometer Depending on the Principle of the Gas Thermometer. M. Veingerov.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 3. *pp.* 119–122, 1936. *In German.*—An apparatus for measuring small radiation intensities and depending on the thermal expansion of a metal, has been described elsewhere [see Abstract 4155 (1936)]. The limiting sensitivity of this instrument has been calculated on the assumption that it is only determined by the Brownian movement. It is suggested that the volume expansion of a gas or a liquid might be used in a similar manner, and the limiting sensitivity is calculated without any reference to the construction of a suitable instrument. The ideal instrument consists of a cylindrical gas

container having a frictionless, movable piston at one end. The radiation passes through one side of the container, falls on the other side which is blackened, and warms the gas. The gas expands and pushes the piston back against a spring, and the intensity is calculated from the new position of the piston. The limit of the accuracy with which the position of the piston can be determined is set by the trembling motion which arises from the blows of the thermically agitated gas molecules. Formulæ, involving the potential energy of a gas molecule, are worked out from the Clapeyron equation, and the minimum intensity which can be measured is given as 3×10^{-19} W. Other aspects of the arrangement are briefly discussed, together with somewhat similar instruments mentioned in the literature.
E. H. D.

5117. Angular Separation in Cosmic-Ray Secondary Electron Pairs. B. Püschel. *Phys. Zeits.* 37. *pp.* 661–663, *Sept.* 15, 1936.—Double coincidence rates were measured with counters under a Pb block, the separation of the counters being varied in order to vary the angle subtended at the Pb. The curve of frequency against angle shows a maximum at about 7°, a rapid falling off to about 14°, and after that a very slow decrease. Placing a sheet of Pb, 0·6 cm. thick, immediately over the counters has the effect of stopping all coincidences at angles greater than about 16°. On the basis of the Geiger and Fünfer classification of cosmic secondary particles [see Abstract 1599 (1935)] the coincidences obtained in the presence of the Pb sheet are due to electron pairs. The experiments allow a relationship to be obtained for the distribution of the pairs with angle of separation; the maximum is at 10°. D. H. F.

5118. Structure of Cosmic Radiation. B. Trumpy. *Zeits. f. Physik*, 102. 9–10. *pp.* 691–696, 1936.—An alternative explanation of the results obtained by Heigert and Bothe [see Abstract 2168 (1936)] is suggested. Experiments with two counters under various dispositions of Pb screens are consistent with this. D. H. F.

***5119. Latitude Variation of Cosmic Radiation in Sea Water at Depths down to 6000 M. H. Hoerlin.** *Zeits. f, Physik*, 102. 9–10. *pp.* 652–677, 1936.—Instruments for the accurate measurement of cosmic radiation in sea water are described and the results obtained with them on an expedition are briefly set out. The maximum latitude variation measured in the Atlantic from the equator to Spitzbergen amounts to 17 % and from the equator to the Magellan Straits 10·5 %. The variation is not symmetrical about the equator. A longitude variation is observed and along the 20° N circle a variation of 5 % is obtained in the Atlantic; the maximum cosmic ray intensity on the equator is found near 80° W. The latitute effect increased rapidly with depth. The reduction ratio with 10 cm. of Fe is also dependent on latitude; it is greater at high latitudes than at the equator for the same depth of water but it is found that the ratio is the same for equal cosmic-ray intensities in different latitudes. H. J. H. S.

5120. Latitude Effect in Cosmic Rays at Altitudes up to 29,000 Ft. I. S. Bowen, R. A. Millikan, S. A. Korff and H. V. Neher. *Phys. Rev.* 50. *pp.* 579–581, *Oct.* 1, 1936.—Accurate measurements with Neher recording electroscopes made both in Peru and in the Philippines on the cosmic-ray ionisation of the atmosphere up to altitudes of 29,000 ft. gave the following results: (1) In both localities the ionisation rises essentially exponentially following a coefficient $\mu = 0\cdot50$ per metre of water. This means that in the equatorial belt the ionisation at 29,000 ft. (two-thirds of the way to the top of the atmosphere) is about 50 ions per cc. per sec., or half its value at the same altitude in the temperate zone. (2) If any longitude effect such as that which we have proved to exist at sea level exists at altitudes of 26,000 ft., it is inside the limits of our observational uncertainty, about 5 %. AUTHORS.

5121. Heavy Particle Component of Cosmic Radiation. R. B. Brode, H. G. MacPherson and M. A. Starr. *Phys. Rev.* 50. *pp.* 581–588, *Oct.* 1, 1936.—A large Wilson cloud chamber was used to study the heavy particles in the cosmic radiation. The chamber had a volume of 7 l. and an illuminated section 5 cm. deep by 30 cm. in dia., so that there was no danger of confusing α-particle tracks with heavy cosmic rays. Heavy tracks made in the 1·5 sec. preceding the expansion were recorded. In 8500 pictures, about 80 heavy tracks were observed. Of these, 21 were made by particles of about the ionisation of slow protons. Their paths could be seen in the illumination for distances equivalent to path lengths of from 13 to 45 cm. in air. 45 less dense old tracks were observed that had an ionisation noticeably greater than an electron track. Of the tracks that appeared to have tripped the counters causing the expansion, 14 were considerably heavier than electron tracks. Three disintegrations with heavy tracks apparently arising from the wall of the chamber were observed. Most of the other old heavy tracks were also probably of secondary origin. It is estimated that about 1 % of the sea-level cosmic ionisation is due directly to heavy particles. AUTHORS.

5122. Production of Cosmic-Ray Showers. A. Bramley. *Science*, 84. *pp.* 206–207, *Aug.* 28, 1936.—It is suggested that the spray of photons found in cosmic-ray showers arises from the collision of a high-energy electron with a proton which is momentarily in the state of a neutron, positron and neutrino. The positron is excited to a high energy level and emits the photons while regaining the ground state. The theory indicates that the showers should contain a preponderance of soft photons of energy about 2 mc^2. F. C. C.

5123. Coincidences of Cosmic-Ray Bursts. C. G. Montgomery, D. D. Montgomery, H. Nie. *Zeits. f. Physik*, 102. 7–8. *pp.* 534–538, 1936. —The conclusions arrived at in a paper by Nie [see Abstract 2707 (1936)] are based on rather uncertain assumptions as to the dependence of the frequency of bursts on their size. That the mean range of the particles forming the bursts is equal to 5 cm. is therefore correct only as to order of magnitude. R. P.

5124. Effect of Paraffin and Lead on the Rate of Production of Very Large Cosmic-Ray Bursts. D. Heyworth and R. D. Bennett. *Phys. Rev.* 50. *pp.* 589–593, *Oct.* 1, 1936.—Observations have been made at sea level of burst frequency and magnitude for bursts larger than 15×10^6 ion pairs, using a Model C cosmic-ray intensity meter. The effects of the following on the rate of production of bursts of different magnitudes have been investigated: (*a*) degree of shielding of the ionisation chamber; (*b*) heavy building structure above the instrument; (*c*) lead placed immediately above the ionisation chamber; (*d*) paraffin placed immediately above the ionisation chamber. The results on the enhancement of burst production by lead agree with, and extend the range of, those already reported. Paraffin has a much smaller effect than lead on the rate of production of large bursts. AUTHORS.

RADIATION, GENERAL THEORY.

5125. Theory of the Photon and the Relativistic Wave Mechanics of Systems. L. de Broglie. *Comptes Rendus*, 203. *pp*. 473–477, *Aug*. 31, 1936.—The author works out the consequences of his hypothesis that photons consist of two complementary particles of equal mass. The equations of motion of the photon are shown to be those of the centre of gravity of the two constituent particles. The density and flux in configuration space must be expressed by a second-rank tensor and not by a vector as in Dirac's theory of the electron. The expression for the probability of the centre of gravity being in a certain part of phase-space which had previously been adopted is now theoretically justified. G. C. McV.

5126. Neutrino Theory of Light. Part I. P. Jordan. *Zeits. f. Physik*, 102. 3–4. *pp*. 243–252, 1936.—A somewhat simplified description is given, using matrix mechanics, of a theory previously advanced [see Abstract 3634 (1936)]. An analogy between the author's method and the Dirac conception of holes is elaborated. The neutrino system can be regarded as composed of two completely uncoupled systems. An interesting supposition concerning the interaction between β-radiation and the neutrino field is postulated. G. O. B.

REFLECTION. REFRACTION AND DISPERSION.

5127. Spherical Aberrations of the Fifth Order in Centred Systems. C. Morais. *Accad. Lincei, Atti*, 23. *pp*. 933–939, *June* 5, 1936.—An analytical treatment of spherical aberrations of any order is developed and the necessary coefficient expressions are evaluated for the case when aberrations of higher order than the fifth are neglected. A numerical example is worked out and the results compared with those given by the trigonometric method. W. S. S.

5128. Separating Power of Dispersive Systems. G. Yvon. *Rev. d'Optique*, 15. *pp*. 215–230, *June–July*, 1936.—The separating power is conceived and defined in relation to the separation of rays. Other factors, however, occur such as width and luminosity of the spectrum and extent and purity of monochromatic rays. The power concerns the multiple possibilities of the dispersion system and its material construction. Seven functions of the wave-length arise and relations can be obtained between any two. The power is given by 10^7 YB where Y is the angular dispersion ($dD/d\lambda$) and B is the size of the emerging beam. The functions are examined and explained and the results tabulated. R. S. R.

5129. Dispersion in Ether Vapour. M. Lombert. *Phys. Zeits. d. Sowjetunion*, 10. 1. *pp*. 1–9, 1936. *In German*.—A photographic method (employing the Jamin interferometer) for determining the refractive indices of gases or vapours is described. The dispersion of ether vapour between 4000 and 5700 Å is measured. The dispersion equation requires only one variable term with $\lambda_0 = 915$. C. B. A.

***5130. Five Theorems for a Mechanical Surfacer. C. Dévé.** *Rev. d'Optique*, 15. *pp*. 201–214, *June–July, and pp*. 241–257, *Aug*., 1936.—A machine for grinding surfaces is described and its mechanism provides means for realising new parameters and gives uniform use for the optical manufacturer. The theory of the instrument is explained in a series of five theorems and their principal applications are set out. R. S. R.

See also Abstracts 5026, 5092, 5164, 5166.

SPECTROSCOPY.

5131. Near Infra-Red Spectrum of Mercury. O. Masaki, K. Kobayakawa and T. Morita. *Hiroshima Journ. Sci.* 6. *pp.* 291–297, *July,* 1936. *In English.*—Eastman P- and Q-plates are used to obtain photographs of the Hg spectrum as far as $1\cdot 2\ \mu$. The 90 measured lines are classified into series, and the classifications are compared with those of other investigations where possible. A. H.

5132. Collisions of the Second Kind and Emission from Na Vapour Mixed with Mg, Zn and Cd Vapours. W. Konowalow and S. Frisch. *Phys. Zeits. d. Sowjetunion,* 10. 1. *pp.* 111–114, 1936. *In German.*—Continuing previous work [see Abstract 3646 (1936)], investigations are carried out upon the part played by collisions of the second kind in the emission from Na vapour when mixed with Mg, Zn and Cd vapours in a discharge tube containing He or Ne and fitted with a hollow kathode. The ratio of the intensity of the Na doublet λ6156 to that of the Na doublet λ4981 is measured for different partial pressures of Na. In the absence of other metal vapours this ratio is observed to decrease with decreasing partial pressure of Na; but when Mg, Zn or Cd is present the opposite is found to be true. The effect is especially marked for Zn and is taken to show that under favourable conditions the Na doublet λ6156 is excited principally by collisions of the second kind with Zn atoms in the metastable $4s4p\,^3P_2$ state. L. A. W.

5133. Effects of Pressure and Current on Intensities of Balmer Lines of Hydrogen. W. W. Jackson. *Phil. Mag.* 22. *pp.* 633–654, *Oct.,* 1936.—Examination by a kathode-ray oscillograph of the characteristics of a discharge-tube excited by unsmoothed supply shows the presence of high kicks of p.d. for small maximum currents at the frequency used, and it is shown that these can be eliminated even with unsmoothed supply by increasing the frequency, a point which may be of electrotechnical interest. Then, using a well-smoothed d.c. supply, a detailed investigation of the effect of pressure and discharge current on the intensities, and on the relative intensities, of the Balmer lines has been carried out. A discussion of the results leads to the conclusions (*a*) that thermodynamic equilibrium is not established in a discharge-tube, (*b*) the excitation-function governs the variation of the intensities of the lower members of the Balmer series, (*c*) the ratio of the number of dispersion electrons associated with H_α and H_β is $5\cdot 07$ at $0\cdot 18$ mm. and 675 mA, (*d*) Cillié's treatment of the Balmer decrement does not give results in accord with experiment. An experiment is suggested whereby information regarding the temperature of the gas in the discharge-tube may be obtained. AUTHOR.

5134. Absorption Spectrum of Potassium. Ny Tsi-Zé and Weng Wen-Po. *Comptes Rendus,* 203. *pp.* 429–431, *Aug.* 18, 1936.—New lines and bands are described in the u.v. absorption spectrum of potassium vapour at temperatures between 500 and 800° C. [See Abstract 3197 (1936).] **Errata,** *ibid. p.* 592, *Sept.* 28, 1936. W. S. S.

5135. Relations in the Atomic Nucleus Deducible from Hyperfine Structure. H. Schüler and H. Korsching. *Zeits. f. Physik,* 102. 5–6. *pp.* 373–378, 1936.—It is shown from a survey of the results of hyperfine structure research that there exist already a number of rules for the structure of the atomic nucleus which are proved to hold without exception as the totality of observational material becomes more nearly attained. These rules relate to the following main features: the absence of a separation of even isotopes; the applicability of a vector model to the nucleus and deduction of the magnetic moment of the neutron; the relative position of the centre of gravity of even isotopes exhibiting the isotope displacement effect; the change in magnetic moments of elementary particles from one element to the next; a relationship between abundance ratios and magnetic moments of elements with odd atomic number and two isotopes of comparable abundance. J. E. K.

5136. Dependence of Nuclear Forces on Spin. C. F. v. Weizsäcker. *Zeits. f. Physik,* 102. 9–10. *pp.* 572–602, 1936.—The exchange force between proton and neutron as a function of position and spin coordinates of both particles and the magnetic moments of proton and neutron are deduced from Fermi's theory of β-disintegration. By applying the Dirac equation to both heavy and light particles, and writing the Fermi interaction in relativistic invariant form one obtains an exchange force between the heavy particles which, like the electromagnetic force, also depends on spin. The same procedure gives an addition to the magnetic moment of the proton and a magnetic moment of the neutron which equals this additional moment numerically and is oppositely directed. The relativistic invariance of the Fermi interaction can be obtained by several assumptions each of which leads to different types of exchange force. The assumption which provides the pure Majorana type of exchange force best supported by experiment provides no magnetic moment. As aids to the main calculation and discussion there are given some general rules relating to the transformation of products of spin matrices and a simplified approach to the transition to Pauli's approximation of spin theory. In comparing the theoretical expectations with experiment it is pointed out that choice of the Fermi law so that the correct order of magnitudes of the exchange force is obtained results in a magnetic moment which is also of the correct order of magnitude. J. E. K.

5137. Deep-Term Relationships of Elements of Iron Group. M. A. Catalán and M. T. Antunes. *Zeits. f. Physik,* 102. 7–8. *pp.* 432–460, 1936.—Striking analogies are observed in the spectra of the elements of the iron group, *e.g.*, in $3d^7 4s^2$ of Co I and $3d^7$ of Fe II. The terms for the configurations nd^m, $nd^m n's$, $nd^m n's^2$, with $m = 2$ to 8, are calculated and are compared with the observed values, the agreement being good. A number of conclusions are drawn from the theoretical results as to the relationships which exist between the energies of the terms in various series, and these are also compared with the empirical results. [See also following Abstract.] C. B. A.

5138. Rydberg-Constant Relationships of Deep Terms of Iron Group. M. A. Catalán and F. Poggio. *Zeits. f. Physik,* 102. 7–8. *pp.* 461–479, 1936.—As a corollary to other work on these spectra [see preceding Abstract] a number of relationships which should exist between the Rydberg constants of various series in this group is deduced and the results compared with experimental observations. C. B. A.

5139. Glow Spectra of Halogen Molecules. Y. Uchida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 651. *pp.* 71–82, *Sept.,* 1936. *In English.*—The spectra emitted by iodine, bromine and chlorine on heating to temperatures of 600° C. and higher are studied. In each case discrete bands and a continuum is observed. All the bands observed have already been observed in absorption. The mechanism of the emission process is discussed at length. A. H.

5140. New Ultra-Violet Bands of SO_2 in Emission. G. Kornfeld. *Faraday Soc., Trans.* 32. *pp.* 1487–1492, *Oct.,* 1936.—An electrodeless discharge of a strong blue colour passed through SO_2 along the walls of a quartz tube through which a spectrogram was taken. Between 2443 and 2120 Å the heads of 59 bands were measured, of which 49 coincided with bands known to belong to SO_2. Neither these nor the remaining 10 could be added to the known system of SO bands, so that there is no evidence of any emission bands beyond its established limit of predissociation. All the bands are consistent with the known band system of SO_2 in emission, and a special scheme has been suggested where the vibrational levels of the ground state are combined of higher numbers of ν_1 and ν_2. AUTHORS.

5141. Nuclear Vibration Bands of Solid Carbon Dioxide. W. Dahlke. *Zeits. f. Physik,* 102. 5–6. *pp.* 360–372, 1936.—An arrangement is described with the help of which the transparency for vibrations of thin layers of CO_2 at low temperatures was measured from the visible region to 17 μ. Three absorption bands of solid CO_2 were found, in which the three most intense rotational oscillation bands of gaseous CO_2 lie. Also relative to the structure certain similarities exist between the CO_2 bands in the solid and in the gaseous condition. There appear in the solid substance also those absorption maxima which in the gas result from the rotation structure. The consequences for the possibilities of motion of the molecule in the lattice are discussed. From the infra-red measurements a spherical pendulum vibration of the two O atoms in relation to the C atom considered as fixed is suggested. J. J. S.

5142. Vibration Levels of Cyclopropane. G. W. King, R. T. Armstrong and L. Harris. *Am. Chem. Soc., J.* 58. *pp.* 1580–1584, *Sept.,* 1936.—The absorption spectrum of cyclopropane is investigated between 10 and 0·8 μ. Qualitative considerations show the symmetry group of the molecule is D_{3h}. The fundamentals are identified by group theoretical correlation with those of C_2H_4 and CH_2. All these frequencies except two, probably outside the range investigated, are identified in the infra-red and Raman spectra. The measurements are inadequate for the assignment of the combination frequencies. H. G. C.

5143. Infra-Red Absorption of Hydrogen Chloride in Non-Ionising Solvents. D. Williams. *Phys. Rev.* 50. *pp.* 719–722, *Oct.* 15, 1936.—The infra-red absorption of HCl in four non-ionising solvents is measured. In every solution studied the HCl fundamental vibrational frequency is found to be lower than for the gas. The variation in frequency is found to increase regularly with dipole moment of solvent when the solvents employed are of the same chemical nature. Solvents of the benzene type are used, and it is found that the displacement of the 3·4 μ band approach no limiting value when a solvent of dipole moment $4{\cdot}20 \times 10^{-18}$ e.s.u. is used. The results obtained are attributed to the combined effects of dipole interaction and the formation of complexes. AUTHOR.

5144. Infra-Red Absorption Spectra of H_2S, HDS and D_2S. C. R. Bailey, J. W. Thompson and J. B. Hale. *J. Chem. Phys.* 4. *pp.* 625–631, *Oct.,* 1936.—The infra-red spectra of H_2S, HDS and D_2S are examined up to 15 μ with a monochromating-prism spectrometer, and the results compared with the Raman spectra. The fundamental frequencies are assigned with reasonable certainty, and a calculation is made of the frequencies corresponding to infinitesimal amplitude. The cruder methods of the vibrational-rotational spectrum suggest a vertical angle of 110°, as compared with 92° obtained previously from a rotational analysis. AUTHORS.

5145. Absorption Spectrum of Cobalt Chloride in Presence of Magnesium Chloride in Aqueous Solution. O. R. Howell and A. Jackson. *Chem. Soc., J. pp.* 1268–1273, *Sept.*, 1936.—The absorption spectra of a series of solutions containing 12 gm. $CoCl_2,6H_2O$/l. with increasing concentration of $MgCl_2$ are measured at 20°. The extinction coefficients at the maxima of the four chief bands, 6950, 6660, 6260, and 6100 Å., are plotted against the concentration of $MgCl_2$. These curves show that no blue constituent is formed until a critical concentration of $MgCl_2$ (575 gm./l.) is reached. The amount of the blue constituent then increases rapidly with increasing concentration of $MgCl_2$, and the relation becomes linear at a concentration of 835 gm. $MgCl_2,6H_2O$/l. The ratio of the relative number of Cl atoms to water molecules in solution at these critical concentrations of $MgCl_2$ is 2 : 3. The mechanism of the change is therefore precisely similar to that caused by addition of HCl to $CoCl_2$ solution: $[Co(H_2O)_6]^{\cdot\cdot} \rightarrow [Co(H_2O)_4Cl_2] \rightarrow [Co(H_2O)Cl_3]'$. The completion of the last stage, yielding $[CoCl_4]''$, is not reached because the ratio of Cl atoms to water molecules is insufficient even in the most concentrated $MgCl_2$ solution. AUTHORS.

5146. Far Ultra-Violet Absorption Spectrum of N_2O. A. B. F. Duncan. *J. Chem. Phys.* 4. *pp.* 638–641, *Oct.*, 1936.—The absorption spectrum of N_2O below 2200 Å has been reinvestigated. Much new material has been found, particularly below 1550 Å, including some discrete systems of bands, and some continuous regions of absorption. No bands are found below 997 Å, but only continuous absorption down to about 850 Å, the limit of observation. A Rydberg series was found, converging to an ionisation potential of 12·66 V. Evidence was found for a total of ten electronic states including the members of the Rydberg series. The vibration frequency in the electronic transition around 1500 Å is 621 cm^{-1}. AUTHOR.

5147. Absorption Spectrum of Chlorine. C. F. Goodeve and B. A. Stephens. *Faraday Soc., Trans.* 32. *pp.* 1517–1518, *Oct.*, 1936.—Another band system in the red beyond 614 mμ was expected, but photographs taken with plates going to 1150 mμ have failed to reveal it. Details of new measurements on the normal band system are given. F. S.

5148. Absorption Spectrum of Chlorine Heptoxide. C. F. Goodeve and B. A. M. Windsor. *Faraday Soc., Trans.* 32. *pp.* 1518–1519, *Oct.*, 1936.—Photographs taken through a quartz tube 30 cm. long show that absorption sets in about 3000 Å and increases continually to 2000 Å which is as far as measurements could be made. Microphotometric tracings were used to determine extinction coefficients. F. S.

5149. Kinetics of OH Radicals as Determined by their Absorption Spectra. Part I. Electric Discharge through Water Vapour. A. A. Frost and O. Oldenberg. *J. Chem. Phys.* 4. *pp.* 642–648, *Oct.*, 1936.—The reaction causing the disappearance of OH radicals after an electric discharge through water vapour is studied by an absorption method, in which relative concentrations of OH are derived by comparing intensities of rotational lines in the O→O band, using calculated values given by the theory of Hill and van Vleck. The effects of the variation of H_2O pressure and of the addition of He are studied. It is concluded that the OH disappears in triple collisions, but no appreciable H_2O_2 is formed. KCl on the surface of the absorption tube increases the rate of the reaction. For clean tubes, the triple collision process $H + OH + M \rightarrow H_2O + M$ is proposed, M being any third molecule. C. B. A.

5150. Absorption of Light by Porphyrins. Part VIII. A. Stern and H. Molvig. *Zeits. f. phys. Chem.* 177. *Abt. A.* 5. *pp.* 365–386, 1936.—Previous work [see Abstract 4207 (1936)] is extended to further derivatives. Nitroporphyrins are found to have absorption spectra in which the bands are displaced towards the red as compared with the non-nitrated compounds. The effect of a sulphonic acid group in the porphin system is similar to that of a carbonyl. The significance of these regularities in relation to the structure of the molecules concerned is discussed. The evidence indicates that the free porphin sulphonic acids exist as inner salts. The introduction of bromine into the porphin system is found to cause characteristically different changes in the absorption spectrum for different positions of substitition. The effects of the introduction of copper into the phorbin and porphin systems are compared and the nature of the combination of the metal discussed. [See following Abstract.] L. A. W.

5151. Absorption of Light by Porphyrins. Part IX. Franziska Pruckner and A. Stern. *Zeits. f. phys. Chem.* 177. *Abt. A.* 5. *pp.* 387–397, 1936.—Previous work [see preceding Abstract] in the visible is extended into the u.v. down to 240 mμ. Normal porphyrins are found to possess a number of bands with very high molar extinction coefficients in this region. Substitution does not seriously displace these bands unless the groups introduced are long chains or contain carbonyl groups. The height of the bands, however, differs very much for different substituents. Porphin possesses one u.v. band of very great intensity, which in mono-imido and β-ϑ-di-imido porphyrins is strongly displaced towards shorter wave-lengths. The change in the u.v. absorption spectrum in passing from the porphin to the phorbin system is investigated and discussed. L. A. W.

5152. Ultra-Violet Spectrum of Ammonia. Part III. A. B. F. Duncan. *Phys. Rev.* 50. *pp.* 700–704, *Oct.* 15, 1936.—The absorption spectrum of mixtures of ND_3, ND_2H, and NDH_2 is obtained from 2200 to 800Å in a normal incidence vacuum spectrograph with a dispersion of about 8·5Å/mm. The spectrum above 1675Å (the end of the first electronic transition) is made up of very diffuse bands. Below 1675 all the bands are sharp. Two electronic transitions are found between 1675 and 1220Å. Each electronic transition is accompanied by many vibrational transitions. Relatively long v' progressions are found for each of the molecules. Evidence for a fourth electronic state below 1220Å was found, but no analysis of the bands could be made. Only one excited state frequency appears for each molecule. This is most probably the parallel deformation frequency, which is also the only frequency found for NH_3 in the u.v. The numerical values of the frequencies are calculated from NH_3 frequencies in corresponding excited states considering changes in mass alone, and agreed with experiment. The electronic terms for the excited states are also calculated. A discussion is given of a possible Rydberg series in NH_3. [For Part II see Abstract 1214 (1936).] AUTHOR.

5153. Band Spectra of MgCl, MgBr and MgI in Absorption. F. Morgan. *Phys. Rev.* 50. *pp.* 603–607, *Oct.* 1, 1936.—The band spectra of MgCl, MgBr and MgI have been studied in absorption. Single systems of four-headed bands, lying between 3600 and 3950 Å for MgCl and between 3800 and 4000 Å for MgBr, have been observed. All of the bands degrade toward the violet. A vibrational anaylsis has been made for each of these systems. These vibrational analyses are consistent with the respective isotope shifts. The analysis of the system for MgCl is not in agreement with that proposed by Parker. A band system, lying between 4040 and 4200 Å and degrading toward the violet, was also observed for MgI. This system is insufficiently developed for a vibrational analysis. AUTHOR.

5154. Spectrum of Indium Oxide. W. W. Watson and A. Shambon. *Phys. Rev.* 50. *pp.* 607–609, *Oct.* 1, 1936.—A rather complex spectrum of InO lying between the two In resonance lines at 4102Å and 4511Å is described. Most of the band heads are assigned to a $^2\Pi \rightarrow {}^2\Sigma$ system with the frequencies of the main ($R_2 + Q_2$?) heads given by the formula $\nu = 23{,}595 \cdot 10 + 626 \cdot 66 \ (v' + \frac{1}{2}) - 3 \cdot 40 \ (v' + \frac{1}{2})^2 - 703 \cdot 09 \ (v'' + \frac{1}{2}) + 3 \cdot 71 \ (v'' + \frac{1}{2})^2 + 0 \cdot 285 \ (v'' + \frac{1}{2})^3$. ν_e for the other spin component is at 23,003·10. The large cubic term causes rapid convergence of the few band sequences, giving rise to prominent " tail " bands. AUTHORS.

5155. Band Spectra of SiH and SiD. G. D. Rochester. *Zeits. f. Physik*, 101. 11–12. *pp.* 769–784, 1936.—The author photographed and analysed the rotation structure of the band 0, 0 of SiH and SiD and the band 1, 1 of SiH. It is shown that the electron jump is $^2\Delta$ (Case b)$\rightarrow {}^2\Pi$ (Case a-b) in agreement with Mulliken's conclusion. The molecular constants for the isotope molecules are derived and their ratios compared with those obtained from mass-spectroscopic data. W. S. S.

5156. Molecular Spectra of Magnesium Deuteride. Y. Fujioka and Y. Tanaka. *Inst. Phys. and Chem. Research Tokyo Sci. Papers. No.* 654. *pp.* 121–137, *Sept.*, 1936. *In English.*—The molecular spectra of MgD in the green region are photographed using a 6m. concave grating in the second order. Seven bands of $^2\Pi \rightarrow {}^2\Sigma$, namely 0→0, 0→1, 1→1, 1→0, 1→2, 2→2, and 2→1 are analysed, and the constants of $^2\Sigma$ and $^2\Pi$ states are calculated. These constants are compared with those of MgH. AUTHORS.

5157. Spectrum and Photochemistry of Carbon Suboxide. H. W. Thompson and N. Healey. *Roy. Soc., Proc.* 157A. *pp.* 331–347, *Nov.* 2, 1936.—The u.v. absorption spectrum of C_3O_2 is measured. It is composed of both banded and continuous regions. With a view to analysis of the band system, the frequencies of the normal valency vibrations of the molecule are calculated, on the basis of the force constants of the linkages involved. A scheme of energy levels for the molecule is suggested which is supported by many considerations. Attempts to excite fluorescence are unsuccessful. Preliminary considerations of the photochemistry of the substance are given. The data on the spectrum are in disagreement with those given recently by Badger and Barton [see Abstract 2509 (1934)]. AUTHORS.

5158. Anomalous Distribution of Intensity in the Band Spectrum of Indium Momoiodide. M. Wehrli. *Helv. Phys. Acta*, 9. 7. *pp.* 587–589, 1936. *In German.*—Photometric measurements of intensities in the band spectrum of In I confirm the anomalous distribution previously suspected. [See Abstracts 3987 and 5060 (1934).] C. B. A.

5159. Optical Absorption by the Alkali Halides. J. C. Slater and W. Shockley. *Phys. Rev.* 50. *pp.* 705–719, *Oct.* 15, 1936.—The relations are investigated between three types of theory for explaining absorption of light by ionic crystals: absorption by independent atoms or ions, absorption according to Frenkel's excitation waves, and absorption according to energy bands and lattice functions, as used in the theory of metals. It is shown that each method leads to a set of unperturbed wave functions, which are related to each other by linear combinations, and that no one set is correct at the actual distance of separation in the crystal. Instead, combinations must be used, leading both to continuous absorption as in the energy bands, as to one or two discrete lines in connection with each continuum, as in absorption by independent atoms or in excitation waves. These conclusions are compared with experiment, explaining in a general way the sharp structure observed both in the near and far u.v. absorption spectra of these crystals. The discussion deals throughout with the undistorted crystal, leaving out of account the new absorption bands which are known to appear in these crystals after considerable illumination, resulting from the deposition of free alkali in the crystal. AUTHORS.

5160. Quartet States in Diatomic Molecules Intermediate between Cases a and b. W. H. Brandt. *Phys. Rev.* 50. *pp.* 778–780, *Oct.* 15, 1936.—The determinantal equation given by Hill and van Vleck for the energies of diatomic molecules intermediate between Hund's cases *a* and *b* has been set up for quartet states and solved by a series method. The solutions are similar in form to those given by Budó [see Abstract 4278 (1935)] for triplet states and the same methods of rotational analysis apply. AUTHOR.

5161. Fluorescence of Aqueous Solutions of Salts of Trivalent Europium. J. Larionov and A. Seidel. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 3. *pp.* 115–118, 1936. *In English.*—The fluorescence spectrum of Eu salts consists of three bands at λλ6965, 6165 and 5935, and radiation of wave-length shorter than λ3200 is required to produce it. The fluorescence only appears in the presence of H_2SO_4. It is believed that the fluorescence observed is to be attributed to the Eu^{+++} ion. A. H.

5162. Zeeman Effect of Lead Line $6p^2\ ^3P_2$—$6p.7s\ ^3P_1$ (4058 Å). S. Satô. *Tohoku Univ., Sci. Reports,* 25. *pp.* 207–216, *July,* 1936. *In English.*—Recently, many reports on the observations of the hyperfine structure of the lead line $6p^2\ ^3P_2 - 6p.7s\ ^3P_1$ have been published. The observation of the Zeeman effect of this line, taking the hyperfine structure in account, seems up till now not to have been undertaken though the effect of the main line has been frequently observed. In this report, the writer wishes to state the results of the observation which he has recently undertaken to study the Zeeman effect of this line together with the theoretical interpretation of it. AUTHOR.

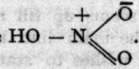
5163. Paschen-Back Effect of Hyperfine Structure in the Caesium Resonance Line at 8522 Å. H. Kopfermann and H. Krüger. *Zeits. f. Physik,* 102. 7–8. *pp.* 527–533, 1936.—The light emitted by a Cs discharge in a magnetic field of 9700 gauss, with the plane of polarisation parallel to the field, is analysed by means of a spectrograph and Fabry-Pérot etalon. In the resonance line 16 components are found. This is a definite confirmation for the value 7/2 of the nuclear spin. The intervals of the splitting pattern are compared with the predictions of quantum mechanics and show very good agreement. R. P.

***5164. Separation of Close Spectral Lines by the Method of Anomalous Dispersion. F. T. Holmes.** *J.O.S.A.* 26. *pp.* 365–366, *Oct.,* 1936.—A column of vapour showing anomalous dispersion can be used as the dispersive element of a "spectroscope." This provides a simple means for demonstrating the essential features of the Zeeman effect of certain elements. AUTHOR.

5165. Stark Effect in the Helium Line $\lambda = 4686$. B. Kullenberg. *Zeits. f. Physik*, 102. 7–8. *pp.* 423–427, 1936.—Preliminary measurements of the Stark effect in He 4686 show one *p*-component displaced towards the red, two *p*-components displaced towards the violet, and an undisplaced *s*-component, of which the red side is much more intense than the violet. This asymmetry in the displacements is very marked at 18 kV/cm. and still exists at 40 kV/cm. At the lowest field strengths, a strong intensity asymmetry is observed in the component $j = 3/2 \rightarrow j = 1/2$, the intensity being greatest on the red side. C. B. A.

5166. Intensity of the Lines of the Benzene Ring in Mono-Substitution Derivatives. E. Vitale. *N. Cimento*, 13. *pp.* 284–289, *June*, 1936.—The relative intensities of the Raman lines associated with the benzene ring were measured for the following substances: benzene, toluene, phenol, aniline and nitrobenzene. Although the Raman line displacements are practically the same for these compounds, considerable variations of intensity are observed. These variations are correlated with differences in the refractivities of the compounds. W. S. S.

5167. Depolarisation of Raman Lines of Tetrachlorethylene. Ta-You Wu. *Chinese Chem. Soc., J.* 4. *pp.* 402–405, *Sept.*, 1936. *In English.*—The degree of depolarisation of the Raman lines of C_2Cl_4 is measured and the fundamental vibrations of the molecule based on these and the infra-red data are discussed. AUTHOR.

5168. Polarisation of Raman Lines in Inorganic Acids. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 174–185, *Aug.*, 1936. —The polarisation of Raman lines of nitric, iodic, sulphuric, selenic and selenious acids is investigated making use of the usual double-image prism method. All the lines of the concentrated HNO_3 except one at 1538 which is attributed to the deformation oscillation of the OH group, show varying degrees of depolarisation which are less than the limiting value 6/7. The lines due to the NO_3 ion possess a state of polarisation which is in agreement with the plane equilateral structure attributed to it. From the results of polarisation 6 lines belonging to undissociated HNO_3 are identified with the known modes of oscillation of an unsymmetrical pyramidal model having a structure  $HO - \overset{+}{N}\begin{smallmatrix}\diagup \bar{O}\\ \diagdown O\end{smallmatrix}$. The state of polarisation of the Raman lines of H_2SO_4 and its dissociation products, HSO_4' and SO_4'' ions generally supports the assumption that all three forms are tetrahedral and that HSO_4' ion is the most distorted. Structural formulæ of the three species and the mechanism of dissociation from one form to the other are discussed in relation to the degree of depolarisation of the breathing frequency. Polarisation of the Raman lines of H_2SeO_4 is analogous to those of H_2SO_4. The results of polarisation of the bands of HIO_3 as well as H_2SeO_3 generally support the previous assignments of these bands to different molecular species. AUTHOR.

5169. Raman Spectra of Trimethylamine and of Hydroxylamine and Hydrazine Compounds. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 204–212, *Aug.*, 1936.—The Raman spectrum of trimethylamine is investigated and the observed frequencies are discussed with the aid of polarisation data. Certain conclusions regarding the proper assignment of the frequencies are drawn from a comparison with the spectrum of iso-butane which has been investigated on a former occasion. The hydrochlorides of hydroxylamine and hydrazine show but a single Raman line in the crystalline state. This line remains quite strong even in aqueous solutions, but the latter also show certain additional features. The constitution of these salts is discussed on the basis of the electronic theory of valency; the conclusions drawn therefrom seem to be supported by the Raman effect. AUTHOR.

***5170. Quartz Spectrograph for Examination of Biological Material. J. S. Foster.** *Canad. J. of Research*, 14. *Sect. A. pp.* 173–176, *Sept.*, 1936.—A quartz spectrograph with Cornu prism is described, in which are combined low cost, unusually high dispersion, and convenience of operation. The general construction is outlined and the special fittings are treated in detail. AUTHOR.

5171. Limits of Detectability of Heavier Inert Gases in Helium. Berta Karlik. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 3–4. *pp.* 145–161, 1936.—Using short-wave excitation, investigations are carried out to determine the minimum concentrations of heavier inert gases which can be detected in He spectrographically, utilising both visible and u.v. regions. It is shown that approximate quantitative determinations can be made at low concentrations by comparison with the principal series of He in the ultra-violet. Under the conditions of the experiments the limiting absolute quantities of gas detectable are: Ne, 5×10^{-7}; A, 6×10^{-6}; Kr, 4×10^{-7}; and X, 6×10^{-7} mm^3. It is believed that by reducing the size of the tube and lowering the total pressure these limits could be reduced without difficulty by a factor between 10 and 50. L. A. W.

See also Abstracts 4933, 4934, 4940, 4951, 5103, 5104, 5189, 5202, 5210, 5234.

VISION.

5172. Curve of Spectral Sensitivity of the Eye. N. T. Fedorov and V. I. Fedorova. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 9. *pp.* 377–380, 1936. *In English.*—The authors give measurements of the luminosity curve of the eye determined under conditions designed to ensure pure cone vision—1·5° field, fully light-adapted eye, with daylight illumination of the laboratory. They find a displacement of the maximum from the value 555 mμ of the standard curve to the value 565 mμ, although in the red end the curves agree. With a larger field and in a darkened room the curve obtained agrees much better with the standard curve. It is suggested that a redetermination of the standard curve is necessary under conditions of pure cone vision. Attention is also drawn to certain irregularities of the curve in the blue end of the spectrum which are associated with fluorescence in the eye. W. S. S.

5173. Correction of Aniseikonia with Ophthalmic Lenses. K. N. Ogle. *J.O.S.A.* 26. *pp.* 323–337, *Aug.*, 1936.—The author gives a general study of the correction of aniseikonia (incongruity of the perceived images of the two eyes). Gaussian paraxial ray theory is applied to obtain quantitative relations between object size and size of the image on the retina for an ametropic eye with an appropriate correcting glass. Even with equal image size on the retinæ of the two eyes, the perceived images may be unequal (basic aniseikonia) due to physiological and anatomical differences in the visual apparatus of the two eyes. In clinical examination such effects are included with actual differences in image size when determining the necessary eikonic correction. The problem of designing unitary corrective lenses to correct ametropia and aniseikonia simultaneously is examined in detail. W. S. S.

See also Abstract 5086.

X-RAYS.

***5174. Ion Tube as X-Ray Generator. K. Hoffmann.** *Phys. Zeits.* 37. *pp.* 694–695, *Oct.* 1, 1936.—A detailed description is given of an improved form of ion tube as a generator of X-rays. Special attention is paid to the ease with which the anti-kathode can be changed. By this means long exposures and continuous working are possible with very little attention to the tube. The running conditions and some necessary precautions are given. The working of this type of tube is compared with that of the electron tube. G. O. B.

***5175. Universal Self-Rectifying Gas X-Ray Tube. J. E. Dorn and G. Glockler.** *Rev. Sci. Instruments,* 7. *pp.* 391–393, *Oct.,* 1936.—The self-rectifying gas X-ray tube described obviates many of the difficulties of this type of tube: maintenance of constant potential and current, sporadic gas discharge and fluorescence on the insulator walls. The tube is of simple and sturdy construction and provision is made for rapid replacement of kathode and anode parts and for focusing the electron beam. The X-ray intensity is very satisfactory and a high current density can be maintained for long periods. C. J. B. C.

5176. Influence of X-Rays on the Stability of Ferric Oxide Sol. J. A. Crowther, H. Liebmann and C. C. Mills. *Brit. J. of Radiology,* 9. *pp.* 631–636, *Oct.,* 1936.—If two samples of a ferric hydroxide sol are exposed near an X-ray tube, one in the beam of X-rays and the other outside it, a difference is produced in their sensitivity to electrolytes. The difference does not increase uniformly with increasing exposure, but shows fluctuations in magnitude which have been followed over exposures ranging from 20 r. to 130,000 r. AUTHORS.

5177. Kβ-Spectra of Chlorine and Sulphur. H. Tazaki. *Hiroshima Journ. Sci.* 6. *pp.* 299–305, *July,* 1936. *In English.*—The Kβ-spectra of Cl and S are investigated by means of a Siegbahn vacuum spectrograph. Several new fine spark lines of Cl are measured. The spectrum of S shows considerable deviations from the results of previous investigators. The results are given in tables and in semi-Moseley diagrams. The origin of a new line (β_5) is discussed, and its probable series indicated. G. O. B.

5178. Energy States of Valency Electrons and X-Ray Levels of Zinc. M. Satô. *Tohoku Univ., Sci. Reports,* 25. *pp.* 197–201, *July,* 1936. *In English. Report No.* 374 *from the Research Inst. for Iron, Steel and other Metals.*—From the L-non-diagram lines and K-absorption edges for the solid and for the vapour of Zn, the absolute value of the K-term is determined and found to be $K = 711\cdot880$ Ryd. Consequently, the absolute values of the crystal levels of the valency electrons in Zn are determined and found to be $E_1 = 0\cdot960$, $E_2 = 0\cdot840$, $E_3 = 0\cdot600$, $E_4 = 0\cdot581$, $E_5 = 0\cdot545$ and $E_6 = 0\cdot021$, all expressed in the crystal Ryd. unit. AUTHOR.

5179. Atomic Number and Influence of Chemical Binding on the K$\alpha_{1,2}$ Doublet of Light Elements. N. G. Johnson. *Zeits. f. Physik,* 102. 7–8. *pp.* 428–431, 1936.—The influence of chemical binding on the K$\alpha_{1,2}$ lines of the elements 12(Mg) and 13(Al) is investigated. The greatest effect, a displacement towards shorter wave-lengths, is observed with the fluorides, when it is nearly twice as great as with the oxides. For the oxides of the elements 12 to 16, the displacement is regularly related to the atomic number of the emitting atom, and a similar result is obtained for the fluorides investigated. C. B. A.

5180. Effects of Chemical Combination on the Kβ Lines of 26 Fe-30 Zn. J. C. McDonald. *Phys. Rev.* 50. *pp.* 694–700, *Oct.* 15, 1936.—The Kβ lines of 26 Fe–30 Zn from the sulphides of those metals are studied in fluorescence with a focusing crystal spectrograph of the Johansson type. The only lines showing a shift from their position in the spectra of the pure metals are the $K\beta_5$ lines of Fe and Ni. Calculation of the second ionisation potential of Cu by application of Pauling's theory gives a value much too high. The term values of the levels in which the $K\beta_5$ has its origin, for Fe, Co and Ni in the sulphides, are somewhat larger than in the pure metal, whereas for Cu and Zn they are about the same. AUTHOR.

5181. K-Spectrum and the Conduction Electrons of Aluminium. J. Farineau. *Comptes Rendus,* 203. *pp.* 540–541, *Sept.* 14, 1936.—K-spectra of solid and liquid Al are studied with a vacuum spectrograph giving high intensity. Solid Al gives β bands, with long wave-length edges at B_a7937 X.U., β_{111} 7811, B_{IV} 7779 and β_V 7900. β_a and β_{111} have widths of 12·2 ± 0·6 volts and 11 ± 1 volts respectively. The other lines are too feeble or partly obscured by β_a and B_{111} for their widths to be measured, but seem to be of the same order as that of β_a. It it is supposed that the M electrons are free, they should occupy an energy band of 11·6 volts. The intensity distribution in the bands do not agree with that calculated by Houston on the free electron hypothesis. With liquid Al the same α lines and the same positions of the short wave-length edges of the β bands are observed as with the solid. The structure of the β_a line is different, however, approaching that calculated by Houston. It is concluded that the BM-electrons in solid Al are in nearly the free state, and in a similar state in the liquid, which varies with temperature. C. J. B. C.

5182. L-Spectrum of Radium(88). H. Hulubei. *Comptes Rendus,* 203. *pp.* 542–543, *Sept.* 14, 1936.—Continuing previous work in the L-spectrum of Ra [see Abstract 4763 (1936)], three of the weaker lines are now given. The L-absorption spectrum is also studied. The three discontinuities are well contrasted and are each accompanied by a white line; those associated with L_{11} and L_{111} being very sharp, and could be measured. From the frequencies obtained from the spectra and employing the experimental absorption frequency for L_{111} the greater part of the energy levels associated with the Ra atom are calculated. C. J. B. C.

5183. X-Ray Satellites, Relative Intensities and Line Widths. L. G. Parratt. *Phys. Rev.* 50. *pp.* 598–602, *Oct.* 1, 1936.—Preliminary data are reported on the $L\alpha_{1,2,3,4,5,6,7}$ lines for Ag(47) and on the Mα, β lines for Au(79) recorded with a two-crystal spectrometer. But the primary purpose of this note is to indicate some of the difficulties in interpreting these and similar data. The disagreement between the present and earier interpretations and results is large: a factor of about 2·5 in widths of M series lines, a factor of about 2 in α_2/α_1 relative intensities, and a factor of about 4 in the satellite relative intensities. These discrepancies are due to differences in (1) the effective resolving power of the instruments used and in (2) the assumed shapes of the component lines comprising an unresolved complex structure. AUTHOR.

5184. Spectral Distribution in Continuous X-Ray Spectrum and Specification of X-Ray Quality. G. E. Bell. *Brit. J. of Radiology*, 9. *pp.* 680–688, *Oct.*, 1936.—This paper is concerned with simple methods of determining the spectral distribution in the continuous X-ray spectrum. After a brief reference to the salient factors concerning the intensity-distribution, a method of analysis put forward by Silberstein and based on filtration data is critically examined, and it is shown that, provided reliable absorption data are used and certain sources of error are avoided, the spectral distribution curves so obtained agree reasonably satisfactorily with those obtained experimentally by various workers. A fair notion of the spectral distribution of a given radiation can accordingly be found from a knowledge of the peak voltage on the X-ray tube and a knowledge of the half-value layer of the radiation in Cu or Al. The half-value layer alone gives, of course, no information concerning the spectral distribution. AUTHOR.

5185. Application of Geiger Counters to the Measurement of Weak X-Ray Intensities. M. Pahl and A. Faessler. *Zeit. f. Physik*, 102. 9–10. *pp.* 562–571, 1936.—The authors seek to apply Geiger Counters to X-ray spectroscopy. Tests are described with the ordinary type of counter, the sensitivity of which is increased by filling it with A. They also work with the counter in a new setting ; in this the X-rays fall at a glancing angle on to one side of the counter, thus increasing the number of electrons produced photoelectrically. The sensitivity is, in this way, greatly increased, especially for the harder rays. A comparison is made with photographic recording. Using the Ag Kβ ray of an intensity such that its effect could conveniently be recorded in a few minutes it is found that an exposure time of about 100 hrs. is required for photographic recording on Laue film. An application of the counter to the determination of small traces of elements in mixtures is discussed. G. G.

See also Abstracts 4956, 4984, 5277.

HEAT.

CALORIMETRY.

5186. Heat Capacities of HCN and H_2S. W. A. Felsing and G. W. Drake. *Am. Chem. Soc., J.* 58. *pp.* 1714–1717, *Sept.*, 1936.—The heat capacities of gaseous HCN and H_2S are determined over a limited temperature interval with an accuracy of approximately 1 %. These are expressed as functions of the temperature. Improvements in measurement of the rate of flow in the construction of the heating unit, and in the gas circulating pump are described. The densities of gaseous HCN are measured with an accuracy of approximately 0·5%. The heat capacity ratios for HCN and H_2S are measured over a temperature range with an accuracy of about 0·2 %. AUTHORS.

5187. Specific Heats and Allotropism in Nickel between 0° and 1000° C. M. Ewert. *K. Akad. Amsterdam, Proc.* 39. 7. *pp.* 833–838, 1936.—A short review of the somewhat confusing literature on the allotropism of Ni is given. The author carries out a calorimetric investigation through the range 0° to 1000° C., from the results of which he obtains values for the specific heats *cp* and the atomic heats C*p*. Since certain changes are rather slow, care must be taken to heat the specimens for a sufficiently long time in making the experiments. From discontinuities in the curves, three forms, α, α' and β are found to exist, with transitions points $\alpha \rightleftharpoons \alpha'$ at 345° C., and $\alpha' \rightleftharpoons \beta$ at 351° C. Values for the heats of transformation are also given. The α- and β-forms are of the cubic system, whilst the α'-form is hexagonal. G. G.

5188. Laws of Heat Conduction in Moving Media. R. Fürth. *Ann. d. Physik*, 27. 3. *pp.* 256–260, *Oct.*, 1936.—Alleges that the work of M. Lang [see Abstract 247 (1936)] contains a number of errors. The theory is criticised point by point and the alleged errors discussed in detail. R. L.

See also Abstracts 4993, 5003, 5096, 5789, 5210.

CONDUCTION.

5189. Accommodation Coefficients and Specific Heats of Hydrocarbon Molecules. O. Beeck. *J. Chem. Phys.* 4. *pp.* 680–689, *Oct.*, 1936.—Accommodation coefficients and specific heats of various hydrocarbon molecules have been determined by a molecular beam method. The theory of the method is considered in great detail, and two simple relations are shown to exist between the accommodation coefficient and the specific heat per mole. The apparatus and its manipulation are also considered in some detail. The value obtained for H_2 is in good agreement with the values obtained by other methods. It is suggested that paraffins and the corresponding olefines have equal accommodation coefficients, and further that their specific heats are equal. The relation of the present work to spectroscopic work in the same field is discussed. **Errata,** *ibid. p.* 743, *Nov.*, 1936. E. H. D.

5190. Influence of Electric Field on Heat Flow in Gases. H. Senftleben and Winifried Braun. *Zeits. f. Physik*, 102. 7–8. *pp.* 480–506, 1936.—It has been found that the rate at which heat is lost from an electrically heated horizontal wire to a surrounding tube is increased by the application of an electric field between the wire and the tube. [See

Abstract 4238 (1934).] Further experiments are now described. The effect only becomes evident when the tube is wide enough for convection to be present. The increased heat loss which is then observed in all gases becomes especially large for dipolar gases, the increased loss in the case of C_2H_5Cl amounting to 50 %. The effect is proportional to the squares of the field strength, the pressure and the temperature excess of the wire, but decreases rapidly as the enclosure temperature is increased. The additional heat flow is considered to result from the marked differences in the values of the electrostriction above and below the wire which are occasioned by the temperature differences set up by the convection currents. R. W. P.

See also Abstracts 4972, 5193.

CONVECTION.

5191. Formation of Vortices by Convection in a Thick Layer of Gas. D. Avsec. *Comptes Rendus,* 203. *pp.* 532–534, *Sept.* 14, 1936.—The cellular polygonal vortices produced in a layer of gas heated below and cooled above, and the bands into which these are drawn out when the gas is in slow movement parallel to the surface, have seldom been observed in gas layers more than 1 cm. thick. The author gives photographs showing the bands obtained in the latter condition for gas layers up to 5 cm. thick, whilst the polygonal cells are obtained for a depth of 2 cm. Tobacco smoke is used to make the movement visible. [See following Abstract.] R. W. P.

5192. Convective Currents in a Layer of Gas Uniformly Heated from Below. D. Avsec. *Comptes Rendus,* 203. *pp.* 556–558, *Sept.* 21, 1936.—Tobacco smoke experiments on the formation of Bénard cellular vortices. The existence of a stable *régime* was observed. Photographs are given of characteristic stages in the development of band vortices. No numerical results are given. [See preceding Abstract.] S. G.

5193. Thermal Conduction of Gases with Free Convection. W. Weizsäcker. *Phys. Zeits.* 37. *pp.* 641–650, *Sept.* 15, 1936.—A horizontal cylinder containing the gas is heated by an electric heater on the axis while its surface is kept at room-temperature. The temperature of the heater is determined by a thermocouple. A second thermocouple can be rotated about the axis at a constant distance from it. Without convection the temperature field should have rotational symmetry and the temperature variation observed upon rotating the thermocouple gives a measure of the contribution of convection to the total heat transfer. In particular for low pressures the convection is negligible and it is thus possible to determine the conductivity and the increase of the heat transfer due to convection. This increase varies with the nature of the gas, with the pressure and with the magnitude of the temperature gradient. It is determined for CO_2, A, H_2, He and air. It is found that the *relative* increase over the value for pure conduction lies on the same curve for different gases if for each gas the pressure is plotted on a different scale. R. P.

5194. Effect of Pressure upon Natural Convection in Air. O. A. Saunders. *Roy. Soc., Proc.* 157*A*. *pp.* 278–291, *Nov.* 2, 1936.—Dimensional considerations suggest that natural convection in air should depend upon the dimensionless number $ag\theta l^3 s\rho^2/\mu k$, the effect of which can be found experimentally by varying either the representative linear dimension l, the representative temperature difference θ, or the pressure of the air. Many experimenters have determined the effect of l and θ upon the heat loss from surfaces to the surrounding atmosphere, but the effect of pressure has not been investigated systematically except in one particular case. The present paper describes measurements with vertical plane surfaces of four different heights in air at pressures from 0·001 to 65 atm. It is shown that the results can be expressed satisfactorily in terms of the dimensionless number, and values are given over a wide range. These are compared with, and are believed to be more accurate than, results of other experimenters obtained by varying the height at atmospheric pressure. Natural convection at higher pressures, up to 1000 atm., is also discussed, and results for a hot wire in N_2 are mentioned. The values of some of the constants are uncertain at the higher pressures, but $asp^2/\mu k$ is not appreciably increased by raising the pressure above about 200 atm. There is evidence from the results that $\mu s/k$ is nearly independent of pressure up to 1000 atm. AUTHOR.

See also Abstract 5191.

DILATATION.

5195. Dilatometric Anomalies in Copper-Aluminium Alloys. A. Boutillier. *Comptes Rendus,* 203. *pp.* 512–514, *Sept.* 7, 1936.—Alloys with 7–16 parts Cu per 100 Al give complex curves with a Chevenard dilatometer. The anomalies are classified as follows: (1) due to changes of density resulting from changes of state; (2) due to plasticity changes, particularly near the 570° C. line; (3) unexplained. An attempt is made to separate these, on the principle that by substituting for the compression of 18–20 gm./mm.^{2} due to the silica rod a tension of equal value, the anomalies due to (2) should be reversed in sign without alteration in absolute value. D. R. H.

See also Abstract 4964.

MELTING AND BOILING POINTS.

5196. Melting Points of Long-Chain Carbon Compounds. A. Millicent King and W. E. Garner. *Chem. Soc., J. pp.* 1368–1372, *Sept.,* 1936.—The heat and entropy increments per methylene group are constant for members of homologous series when the number of C atoms in the chain exceeds 10. The polymorphic modifications of long-chain compounds can be sharply divided into two classes, *viz.,* those with vertical and those with tilted chains. For the former, the heat and entropy increments of crystallisation are small and variable from series to series, but for the latter, they are large and constant for all series so far investigated. The vertical forms possess oscillating or rotating chains, and abnormally high specific heats, coefficients of expansion, and cross-sectional areas of the chains in the solid state. The theory of the convergence of the melting-points of long-chain compounds is discussed, and the rise in the melting points with increasing chain length is ascribed to negative heats of crystallisation in the neighbourhood of the terminal groups. It is concluded that the vertical chains are more stable than the tilted chains at the melting point for compounds with very long chains. [See following Abstract.] AUTHORS.

5197. Heats of Crystallisation of Methyl and Ethyl Esters of Monobasic Fatty Acids. A. Millicent King and W. E. Garner. *Chem. Soc., J. pp.* 1372–1376, *Sept.,* 1936.—The specific heats and heats of crystallisation of the following esters of the straight-chain fatty acids are measured: methyl, C_{16}, C_{18}, C_{20}, C_{22}, and C_{19}; ethyl, C_{17} and C_{19}. Two equations are derived connecting the melting points with the number of C atoms in the chain, for the methyl esters of the even series and the ethyl esters of the odd series, severally. [See preceding Abstract.]

AUTHORS.

5198. Deviation of Wet-Bulb Temperature from Temperature of Adiabatic Saturation. D. Dropkin. *Cornell Univ. Experiment Sta., Bull. No.* 23 [45 *pp.*], *July*, 1936.—An experimental investigation is described, in which wet-bulb depressions of from 7° F. and 20° F. are used, which shows that only at an air velocity relative to the wet-bulb of 1025 ft./min. is the actual wet-bulb temperature equal to the temperature of adiabatic saturation. At higher velocities than this the wet-bulb temperature is less than the temperature obtained under conditions of adiabatic saturation. This can only be explained by the ratio of the coefficient of heat transfer to the coefficient of evaporation being smaller than the humid specific heat of the air. As the air velocity is decreased the wet-bulb temperature becomes steadily higher than the temperature of adiabatic saturation. This is in part due to the effect of radiation becoming more pronounced, but further work is considered necessary to ascertain whether radiation accounts for the whole of the deviation.

R. W. P.

See also Abstracts 5003, 5029, 5096, 5211.

TEMPERATURE, MEASUREMENT OF.

***5199. Platinum Resistance Thermometer as a Secondary Standard of Temperature between 14° and 90° Abs. F. Henning and J. Otto.** *Phys. Zeits.* 37. *pp.* 639–641, *Sept.* 15, 1936. *From the Reichsanstalt.*—The authors point out that it is generally considered necessary to determine 5 fixed points for calibrating a Pt resistance thermometer. In the range 20°–90° Abs. the normal boiling point of O_2, the triple point of H_2 and the normal boiling point of H_2 are easily determined, but the other two fixed points consisting of the triple point of N_2 and the β-γ transformation point of O_2 require an extensive set of experiments for which few laboratories are suitably equipped. Moreover, the existing measurements differ widely, and, to overcome these difficulties, the possibility of correlating the resistance ratios $r_t = R_t/R_0$ of two Pt thermometers with temperature is discussed. The constants in Henning's formula $\Delta r_t = (T - 273)[A + B/(T + 10)]$ are determined from measurements at the normal boiling points of O_2 and H_2, and the errors involved by the use of this formula are shown graphically, and also in a table, for 5 pairs of resistance thermometers. In general the formula is found to give satisfactory results, the maximum error being 0·14° within the range 20°–90° Abs.; the empirical nature of the formula is indicated by the falling off in accuracy below 20° Abs. Furthermore, it is found that the use of a thermometer with very high resistance ratio leads to errors of the order of 0·70°, and the greater the purity of the Pt the better the results. For this reason it is suggested that a central source of Pt of known and constant purity be set up for supplying wire to workers in the low-temperature field.

A. G. Q.

***5200. Portable Aradiant Convection Pyrometer. F. T. Barr and R. F. Berger.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 393–395, *Sept.* 15, 1936.—Radiation errors occurring in the measurement of the temperature of gases are discussed, together with methods of shielding thermocouple elements. The element should be small as the radiant heat transfer takes place at the surface of the element, while the convection transfer takes place at the surface of a stagnant film surrounding the element, and of greater area. As the coefficient of heat transfer by convection increases with the velocity of the gas past the element, a suction method is used. Two instruments are described, and these are designed so that (1) the gas velocity past the element is sufficiently large to make the radiation transfer negligible, (2) small leads make the conduction negligible, (3) only a small amount of gas is diverted from its normal path, (4) the gas can be cooled before it reaches the suction mechanism. The construction is given in some detail, and the sensitivity, lag and calibration are discussed. E. H. D.

***5201. Applications of Photo-Thermometry. P. Neubert.** *A.T.M. No.* 63. *T*114–*T*115, *Sept.*, 1936.—In a previous paper [see Abstract 4782 (1936)] a new method of measuring surface temperatures by means of infra-red photographs was described. The present paper deals with practical applications of the method. Natural and infra-red photographs of three pieces of apparatus at temperatures of 350°–400° C. are given, and in the case of two of these temperature distribution curves are given. A photograph of one of the photometric curves is included. It is necessary to know the emission coefficient of the material whose temperature is to be measured, and the method of so doing is described. A polished cylinder of the metal concerned has a hole 1 mm. in dia. and 5 mm. long drilled in one side, and the surfaces of this hole are blackened with Co oxide. The cylinder is placed in an electric oven, and a rotating sector is arranged to cover the part of the cylinder containing the hole. A number of infra-red photographs are taken with different sector apertures, and the emission coefficient is deduced from photometric measurements on the resulting plate. The values of several such determinations are discussed with reference to the literature. E. H. D.

See also Abstract 5003.

THERMOCHEMISTRY.

5202. Thermal Dissociation and Absorption Spectra of Vapours of KNO_2, KNO_3, $NaNO_3$, and $AgNO_3$. K. Butkow and W. Tschassowenny. *Acta Physicochimica*, 5. 1. *pp*. 137–159, 1936. *In German.*—The thermal dissociation products of KNO_3, KNO_2, $NaNO_3$ and $AgNO_3$ have been spectroscopically investigated and also their vapours except $NaNO_3$. Full experimental details with tables of data are given. It is established that these nitrites and nitrates do not consist of ions in the vapour state but possess covalent unions. The bond energies are all calculated and it is shown that the energy of the semi-polar bond (N→O) in the nitro-group amounts to 92 k.cal./mol. The semi-polar bond is found to be destroyed during the photo-dissociation of the metallic nitrates, of nitric acid and of ethyl nitrate. An interpretation of the spectrum of the aqueous solution of KNO_2 is included. H. H. Ho.

5203. Single Bond Energies. Part III. C–C Bond in Diphenyl Di-biphenylene Ethane. H. E. Bent and J. E. Cline. *Am. Chem. Soc., J.* 58. *pp.* 1624–1627, *Sept.*, 1936.—The heat of oxidation of diphenyl di-biphenylene ethane is found to be about 20 k.cal. less than that of hexaphenylethane. This datum indicates that steric hindrance is less than in the case of hexaphenylethane and that the free radical formed by dissociation, phenyl fluoryl, has more resonance energy than triphenylmethyl. [For Parts I and II see Abstract 1261 (1936.] AUTHORS.

5204. Ignition of Explosive Gases. G. Mole. *Phys. Soc., Proc.* 48. *pp.* 857–864, *Nov.* 1, 1936.—It is shown that the activation theory of ignition, when expressed mathematically, leads to a differential equation, the general ignition equation, which represents the state of an ignitable mixture. This equation yields solutions which agree closely with the fundamental phenomena of ignition. AUTHOR.

5205. Explosive Combustion of Hydrocarbons. W. A. Bone and L. E. Outridge. *Roy. Soc., Proc.* 157*A*. *pp.* 234–248, *Nov.* 2, 1936.—The paper deals with certain effects of dilution with inert gases (A, He, and N_2) upon explosions of equimolecular mixtures of ethylene or acetylene and oxygen, *i.e.*, $C_2H_4 + O_2$ and $C_2H_2 + O_2$ which normally give rise to CO and H_2, without any separation of C or steam-formation, in accordance with the equations: $C_2H_4 + O_2 = 2CO + 2H_2$, and $C_2H_2 + O_2 = 2CO + H_2$, respectively. It is now shown by chemical, photographic, and spectrographic tests that sufficient dilution of such media, while not much affecting the main result, may induce some secondary C deposition and steam-formation on explosion when the mean flame temperature is thereby reduced to a point well below 2000° C., such result being probably due to the fall in flame temperature induced by dilution. AUTHORS.

5206. Optical and Physical Effects of High Explosives. R. W. Wood. *Roy. Soc., Proc.* 157A. *pp.* 249–261, *Nov.* 2, 1936.—The first part of the paper describes and explains phenomena including the plastic flow of metals produced by the enormous instantaneous pressure developed by detonation. Experimental work is discussed in which detonators were fired from various distances against different obstacles, *e.g.*, a pellet of soft Cu was found to penetrate a block of steel to a depth of $\frac{1}{8}$ in. Fired against a sheet of paper it was shown that the solid pellet was accompanied by some 60 or 70 smaller fragments all travelling in the same general direction, and each one of which moving with such a velocity that its impact on a brass block caused a " crater " with a raised rim, as though the metal had actually been melted by the heat generated by the impact; it was found, however, that a plastic flow had really occurred. Experiments are next described dealing with the secondary flash of detonation, and with the spectra of deflagration and detonation. The inference from photographs is that either undecomposed fulminate is thrown off from the detonating cylinder which immediately deflagrates, or that a 2-stage reaction occurs, the products of detonation subsequently detonating; the comparatively small amount of light given off favours the first hypothesis. H. H. Ho.

5207. Theory of Monomolecular Reactions. L. Landau. *Phys. Zeits. d. Sowjetunion*, 10. 1. *pp.* 67–77, 1936. *In German.*—The velocity of decomposition of large molecules is examined mathematically. At high pressures such reactions are monomolecular and their velocity is independent of pressure; the time occupied in the decomposition of an activated molecule is large in comparison with that between two collisions. At low pressures these two times are of the same order of magnitude and the reaction becomes bimolecular and dependent on pressure. The gradual passage from one law to the other in the intermediate stage is discussed, and detailed formulæ are worked out. C. A. S.

See also Abstracts 4973, 5197.

THERMODYNAMICS.

5208. Calculation of the Latent Heat of Ebullition. P. Guareschi. *Accad. Lincei, Atti,* 23. *pp.* 783–787, *May* 17, 1936.—Starting from Edser's formula for the total work necessary to remove a molecule from an infinite plane surface, the latent heat per unit volume and the total latent heat of a liquid are calculated. These expressions involve a factor depending on the degree of association of the liquid. Agreement with experiment is satisfactory for unassociated substances, but not for water and alcohols. If for these liquids degrees of freedom are attributed not only to rotation but also to translation and deformation of the molecule, *i.e.*, 9 degrees of freedom in the case of the water molecule and 12 for methyl and ethyl alcohols, the calculated latent heats are in better accord with experimental data. The coefficients of association of these liquids at their boiling points are also computed. C. J. B. C.

5209. Free Energy of Electron Gas. A. R. Gordon. *J. Chem. Phys.* 4. *pp.* 678–679, *Oct.*, 1936.—The energy and free energy of a semi-degenerate gas obeying the Fermi statistics are computed as functions of temperature and concentration. The significance of the deviation of the free energy from the limiting high temperature value is illustrated by calculating the degree of thermal ionisation of K vapour under conditions of high electron concentration. AUTHOR.

See also Abstracts 4926, 4959, 5012, 5018, 5019, 5020.

VAPOUR PRESSURE.

***5210. Vapour Pressures of Indium Halides. C. Robert.** *Helv. Phys. Acta,* 9. 6. *pp.* 405–436, 1936. *In German.*—Apparatus is described for simultaneous measurements of vapour pressures and absorption spectra. The vapour pressures are determined within the pressure range 1 to 760 mm. of Hg., and up to temperatures of 950° C. by means of a method involving a compensated spiral manoneter. The salts examined are InCl, InBr, InI, $InCl_2$, $InBr_2$, $InCl_3$, and $InBr_3$. For each salt straight lines are obtained when the logarithm of the saturation pressure is plotted against the reciprocal of the absolute temperature. From these lines the mean heat of vaporisation is determined and also the respective boiling or sublimation temperatures. $InCl_3$ and $InBr_3$ appear to undergo sublimation as the temperature obtained is below the melting point of the salt. Pressure measurements on the superheated vapours indicate that above a certain temperature they all obey the ideal gas law, and do not appear to be polymerised. At lower temperatures the measured vapour pressure is smaller than the calculated. The spectroscopic observations indicate that the vapours of the di- and tri-halides have an u.v. continuum, which extends towards longer wave-lengths as the pressure increases. R. W. P.

5211. Vapour-Pressure Curves and Triple Points in the Temperature Range 14°–90° Abs. F. Henning and J. Otto. *Phys. Zeits.* 37. *pp.* 633–638, *Sept.* 15, 1936. *From the Reichsanstalt.*—In connection with an investigation of the Pt resistance thermometer and the gas thermometer a series of vapour-pressure curves and fixed points is determined. The gases investigated are H_2, Ne, N_2 and O_2, between the triple and boiling points. The results are given in tabular form, and the values of the boiling and triple points to be found in the literature are tabulated, together with the methods used. It is shown that there is good agreement between the results of the various observers, when the figures are reduced to a common value for the ice-point, namely, 273·16° Abs. E. H. D.

ACOUSTICS.

5212. Vocal Resonance. D. Lewis. *Acoustical Soc. of America, J.* 8. *pp.* 91–99, *Oct.*, 1936.—A procedure is described for investigating the resonance properties of the vocal cavities. Trained male voices sang specified vowels at a medium loud level in a dead room at about 14 in. from a pick-up microphone. Oscillograms covering about 1/2 sec. were made during the middle portion of a vowel sustained for about 6 sec. All the waves in each oscillogram were measured for fundamental frequency and waves were then selected for analysis from those within certain pitch vibrato cycles. The results of the analysis are given in the form of graphs of relative intensity against frequency. The graphs include partials up to the 35th, and it is noted that the relative intensity levels of the various partials changed as they changed in frequency. Also the curves for certain partials, when viewed together, form contours, which resemble the response curves of simple resonators. The evidence as a whole, however, indicates that there are no fixed resonators of any appreciable importance, although there may be cavities, the larynx for example, which tend to become more or less fixed when a singer produces sustained vowels at a given pitch. G. E. A.

5213. Circular Transverse Vibrations of a Hollow Quartz Cylinder. Ny Tsi-Zé and Fang Sun-Hung. *Comptes Rendus*, 203. *pp.* 461–463, *Aug.* 24, 1936.—A hollow cylinder of quartz of which the axis is parallel to the optic axis of the quartz will vibrate if suitably connected in an electric circuit. It possesses five fundamental frequencies of which the most easily excited is that which corresponds to a circular transverse vibration. The characteristics of this form of vibration have been studied, and it is found that when the ratio r/R is less than $0 \cdot 5$ (r and R being the internal and external radii respectively) the cylinder vibrates in three segments, the frequency being $260/(\pi/3)(r + R)$ kc./sec. If r/R is greater than $0 \cdot 5$ the cylinder vibrates in 6 segments, the frequency being $277/(\pi/6)(r + R)$ kc./sec. The above expressions are the result of measurements upon about 20 cylinders. The temperature coefficient depends upon the value of r/R, being negative when it is less than $0 \cdot 5$ and positive when it is greater. It is pointed out that by suitable adjustment of r/R it should be possible to obtain a zero temperature coefficient. J. E. R. C.

5214. Theory of Sound Dispersion. L. Landau and E. Teller. *Phys. Zeits. d. Sowjetunion*, 10. 1. *pp.* 34–43, 1936. *In German.*—It is shown that the sound dispersion at temperatures which suffice for the excitation of several vibration quanta is given by the same formula as at temperatures at which at most one vibration quantum is excited. Investigation is also made of the delivery of vibration energy in its dependence on the molecular velocity. Thus it is established that only great velocities play a part, with which the phenomenon proceeds classically. The dependence on temperature of the effect is determined. J. J. S.

5215. Velocity of Sound in Liquid Oxygen. H. W. Liepmann. *Helv. Phys. Acta*, 9. 6. *pp.* 507–510, 1936. *In German.*—The velocity of sound in liquid oxygen is measured at a frequency of 7500 ∼ in the temperature range − 183·6° C. to − 209·5° C. It is found to increase with decreasing temperature being 903 m./sec. at − 183·6° C. and 1111 m./sec. at − 209.5° C. J. E. R. C.

5216. Absorption of Elastic Waves in Fluids. R. Lucas. *Comptes Rendus*, 203. *pp*. 459–461, *Aug*. 24, 1936.—It is known that the absorption of ultrasonic radiation in fluids is much greater than the theories of Stokes and Kirchhoff would predict [see Abstracts 401 (1935) and 1776 (1936)]. The author attributes this to minor variations of density in the fluid and instances in support of this that a mixture of nitrobenzene and hexane has a much higher absorption than that of either alone. A calculation is made and a formula deduced for the effect of such density variations. A formula is also deduced for the case in which the density variations are those to be expected in a Debye system of longitudinal waves. J. E. R. C.

5217. Absorption of Ultrasonic Waves by Liquids. P. Biquard. *Ann. de Physique*, 6. *pp*. 195–304, *Sept*., 1936.—The treatise deals with the absorption of ultrasonic waves by water and a number of organic liquids. The waves were supplied by three harmonics of a quartz plate which had frequencies from 4 to 11×10^6 ∼. Two methods of measuring the coefficients of absorption were employed which depended on (*a*) the effect of radiation pressure on a torsion pendulum, and (*b*) the diffraction of light by the waves. The values of the coefficients found are from 3 (acetone) to 100 (benzene) times greater than those required by classical theory. Further, the law of proportionality of absorption to the square of the frequency does not always hold. Different hypotheses are put forward to explain the discrepancy, notably the scattering of the waves, and the non-validity of Stokes' hypothesis in the calculation of the viscosity of a fluid. A Bibliography is appended. G. E. A.

5218. Ultrasonic Velocities in Organic Liquids. Part VI. S. Parthasarathy. *Indian Acad. Sci., Proc.* 4*A*. *pp*. 213–215, *Aug*., 1936.—The paper gives determinations of acoustic velocity, by the method of diffraction of light by h.f. sound waves, in four esters, three nitro-compounds, two aldehydes, in thymene oil and in oil of turpentine. Adiabatic compressibilities are also given. [See also Abstract 4803 (1936).] AUTHOR.

5219. Diffraction of Light by H.F. Sound Waves: Generalised Theory. N. S. N. Nath. *Indian Acad. Sci., Proc.* 4*A*. *pp*. 222–242, *Aug*., 1936.—A general review of the theory of the diffraction of light by h.f. sound waves [see Abstract 3772 (1936)] is presented. The solution of the difference—differential equation due to Raman and Nath is attempted here by the series method. The results obtained offer an explanation for the experimental results due to Bär and Parthasarathy who have studied the phenomenon at oblique incidence of light to the sound waves. That the idea of "propagation" of light in a quasi-homogeneous medium is fundamental and preferable to the undefined idea "reflection" in such a medium, is pointed out. AUTHOR.

5220. Intensity Measurements in the Diffraction of Light by Ultrasonic Waves. F. H. Sanders. *Canad. J. of Research*, 14. *Sect. A*. *pp*. 158–171, *Aug*., 1936.—Measurements of the distribution of light energy among the various orders of the diffraction pattern produced when monochromatic light is passed through a liquid subjected to h.f. ultrasonic disturbances have been carried out over a range of ultrasonic intensities at frequencies in the region of 5 megacycles per sec. Both progressive and standing wave fields have been studied. Results of the experiments show excellent agreement with the theory of Raman and Nath for the variation in degree of scattering with varying ultrasonic intensity. Absolute measurements of the sound intensity conducted with a torsion pendulum are in good agreement with that expected from the theory for the liquids and light wave-lengths involved. AUTHOR.

5221. Method of Making Stationary Ultrasonic Waves in Liquids Visible. D. Nomoto. *Phys. Math. Soc. Japan, Proc.* **18.** *pp.* **402–424,** *Aug.*, **1936.** *In German.*—The light from a mercury-vapour lamp is passed through a condensing lens, filter and slit to a collimating lens. Parallel rays pass through the glass trough containing the liquid in which the stationary h.f. sound waves are produced, and form a series of parallel bands on a screen. As the screen is moved away from the trough, the lines alternately appear and disappear. The speed of sound in transformer oil was determined by the above method and also by those of Debye-Sears and Hiedemann; the values found were **1460·0, 1459·0** and **1453** m./sec. It is shown that the distance between the bands is independent of the distance of the photographic plate from the plane of emergence of the light from the sound waves. The method, of which the theory is given, is suitable for use with frequencies from 600 to 2000 kc. G. E. A.

5222. Light Modulation by H.F. Sound Waves. H. E. R. Becker. *Hochfrequenztechn. u. Elektroakustik,* 48. *pp.* 89–91, *Sept.*, 1936.—An arrangement is described for the modulation of light by means of h.f. sound waves which possess extremely small voltages and energies (20 V and 0·1 W). Thereby any given intensities can be modulated. The arrangement uses the Debye-Sears diffraction phenomenon [see Abstract 4457 (1932)]. Parallel beams of light are passed through a trough of liquid and an excited plate of piezoelectric quartz produces h.f. sound waves which traverse the light bundle at right angles, and by means of a reflector a stationary h.f. sound wave is produced. The light is brought to a focus beyond the trough, and the diffraction phenomena observed. At voice frequencies (up to 15,000∼) the arrangement is extraordinarily simple and yields all frequencies absolutely undistorted. The inertia of the arrangement is practically only due to the time of travel of the sound wave. For frequencies of modulation up to over 10^6∼, as for long-sighted purposes, arrangements are given which serve to eliminate the inertia of the sound wave. J. J. S.

5223. Stroboscopy in the Ultrasonic Region. E. Hiedemann and K. H. Hoesch. *Zeits. f. Physik,* **102. 3–4.** *pp.* **253–258, 1936.**—The usual method of stroboscopically illuminating ultrasonic vibrations uses a Kerr cell in the path of the light. Alternative methods, some of which are claimed to be better than the Kerr cell method, are discussed in this paper. They are (1) to replace the Kerr cell by a glass block through which ultrasonic radiation is passing and (2) to use light diffracted by the grating formed by an ultrasonic stationary wave pattern in a liquid. In the latter case the intensity of the illumination is modulated with twice the frequency of the radiation. Photographs obtained by these methods are reproduced and compared with those obtained using a Kerr cell. J. E. R. C.

5224. High-Intensity Sound Waves. C. G. Suits. *Gen. El. Rev.* **39.** *pp.* **430–434,** *Sept.*, **1936.**—High-intensity sound waves produced by spark discharges and other sources have been photographed chiefly by the methods of Dvorak and the Schlieren method of Töpler. These methods take an instantaneous exposure of a sound wave by virtue of its refraction shadow. By combining the principle of the shadow method and the rotating-mirror camera, it is possible to obtain a continuous record of the passage of a sound-wave very near to the sound source. Extinction of discharges by sound waves and sound energy produced by sparks are discussed, concluding with a theory of extinction by sound. J. E. B.

5225. Supersonic Absorption in Liquids and Related Optical Phenomena. L. Mandelstam and M. Leontovič. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 3. *pp.* 111–114, 1936. *In German.*—The absorption of sound waves in liquids in the region of $10^8\sim$ is discussed and compared with related optical phenomena. The Kneser theory for gases in then briefly considered with respect to liquids, and difficulties which arise in the hydrodynamic theory are shown to receive a natural explanation. H. H. Ho.

5226. Resonance Effects in Rooms, their Measurement and Simulation. W. Bürck, P. Kotowski and H. Lichte. *E.N.T.* 13. *pp.* 268–279, *Aug.*, 1936.—Resonance effects in rooms are dealt with from the point of view of equalisation phenomena of excited oscillating electrical circuits and by consideration of such circuits the effects are separated into their individual components and explained. Different ways are described for producing artificially, by electrical means, a given resonance effect. The various methods principally used for resonance measurement are discussed and their possible errors are investigated. For determining reverberation effects as simply as possible and with an accuracy sufficient for practical requirements it is considered that the method of impulse measurements, with use of band filters, is satisfactory. A. W.

5227. Room Designed for Free Field Measurements. E. H. Bedell. *Acoustical Soc. of America, J.* 8. *pp.* 118–125, *Oct.*, 1936.—This paper gives some data on the absorbing material used in a room recently completed and intended for acoustical measurements under essentially free field conditions. The absorbing material, which consists of a number of layers of cloth separated by air spaces, is shown to have an absorption coefficient of the order of 98 to 99 % over a wide frequency range. Some data are also given showing the degree of departure of the sound field in the room from the field to be expected in free space. It is shown that it may not be possible to duplicate a free field in an enclosed room, regardless of the freedom from interference obtained, because of the fact that the pressure may decrease more rapidly than the inverse distance law applying to a free field. AUTHOR.

5228. Nature of Tonal Brightness. E. G. Boring and S. S. Stevens. *Nat. Acad. Sci., Proc.* 22. *pp.* 514–521, *Aug.*, 1936.—Cardboard sirens were rotated by motors and sounded by compressed air, and listeners agreed that the brightness of the notes heard varied directly with the linear velocity of the sirens. The frequency spectra and wave-forms of certain siren notes are compared, and the authors conclude that the brightness of tones and tonal complexes varies directly with the intensity and with the frequency of the stimulus, after the manner of tonal density. Tonal brightness and tonal density are thus probably to be identified. [See also Abstract 4275 (1934).] G. E. A.

See also Abstracts 5004, 5030, 5262, 5318.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

5229. Radiation and Breakdown. W. Rogowski and A. Wallraff. *Zeits. f. Physik*, 102. 3–4. *pp.* 183–200, 1936.—The well-known square law for the decrease of sparking voltage for weak radiations is derived in a more rigorous form. For intense radiation the calculation gives a logarithmic decrease. In the derivation of the square law only the influence of space charge on the positive ionisation is considered, but if the influence on the electronic ionisation is also taken into account, it is found that, near the minimum sparking voltage, an increase in the sparking voltage (instead of a decrease) may be observed under certain conditions. Seitz and Fuchs have verified this deduction experimentally. The distortion of the electric field and the current on reaching the breakdown voltage are discussed at length. [See also Abstract 279 (1936.)] H. J. H. S.

5230. Kathodic Processes in Arc Discharges. O. Becken and K. Sommermeyer. *Zeits. f. Physik*, 102. 9–10. *pp.* 551–561, 1936.—Two forms of arcs are described. In arcs of type I the focal spot emits very little light and is in a state of great agitation; its fall of potential varies very little with the gas pressure. In type II it is bright and stationary; its fall of potential increases with decreasing gas pressure. Experiments show that arcs of type I are to be regarded as " field arcs " and that they exist only when the kathode has on it a layer of gas. Arcs of type II are " thermal arcs." Tungsten and carbon can both give, in N_2 gas, arcs of the two types depending on conditions, whilst Cu and Fe only give the field arc. G. G.

5231. Cloud Tracks of the Negative Surface Discharge. F. Trey. *Phys. Zeits.* 37. *pp.* 688–690, *Oct.* 1, 1936.—A glass plate is placed in an expansion chamber and the tracks formed due to the negative surface discharge at 14 kV are examined. The tracks, which are about 1 cm. long have a radial distribution. Many examples of swirling tracks are found and these are attributed as much to motion of the ions in the electrical field as to mechanical disturbance of the air. F. C. C.

5232. Townsend Coefficients and Spark Discharge. D. Q. Posin. *Phys. Rev.* 50. *pp.* 650–658, *Oct.* 1, 1936.—The Townsend coefficients α and β are measured in purified nitrogen. He studies the variation of X/p with α/p, where X is in V/cm. and p is the pressure in mm. of Hg. There are three ranges of X/p in which the variation of α/p follows entirely different equations. The first range is for X/p between 20 and 38; the second for X/p between 44 and 176, and the third for X/p between 200 and 1000. In the first region Townsend's Equation holds up to the passage of a spark, but deviations from it occur when X/p is about 100. From these deviations β can be calculated. To get true values of β low current densities giving no space-charge must be used. He concludes that the secondary ionisation, measured by β, is not due to ionisation by positive ions, but is most probably due to photoelectric ionisation at the kathode. G. G.

5233. Spray Discharge. H. Schnitger. *Zeits. f. Physik*, 102. 3–4. *pp.* 163–182, 1936.—Measurements are described with spray electrodes of a new type, in which the insulating layer consists of a thin film of

Al_2O_3 formed electrolytically. The current-potential law previously found for the spray discharge [see Abstract 830 (1935)] was tested by short-time oscillographic measurements with ocelit kathodes. A new effect of the surface properties of the kathode on the spray discharge was investigated. Using a 50-cycle a.c. supply measurements were made with an oscillograph of the reignition potential of the spray discharge. The residual charge on the insulating layer was found to have a marked effect on this potential. An arrangement is described by means of which the reignition potential was reduced to 217 V, the value obtained with the normal arrangement being 465 V. With the lower voltage a considerable rectifying action occurs. A. W.

5234. Condensed Discharges in Gases at Low-Pressure. Z. Bay. *Zeits. f. Physik,* 102. 7–8. *pp.* 507–526, 1936.—The electrical and spectroscopic properties of very short impulse discharges of high intensity, in H_2, N_2, Ne and Ne-Hg mixtures are examined. The measurements of the impulse time and current intensity are made by two methods. In the first, the impulse period is measured photographically and from this and the effective current, the maximum current intensity is estimated. The second method is independent of the light emission of the discharge and the current density is calculated from the ratio of the linear and mean square current values. Current densities up to 1200 A are obtained, and it is possible to follow the change over from glow to arc discharge. In the spectroscopic observations considerable changes are noted as the discharge current increases. The H_2 spectrum weakens and the Balmer series is enhanced at 50 to 200 A; with currents of more than 1000 A the Balmer lines are very strong but diffuse, and the continuum extends from the u.v. to the red. In N_2 at 200 A the second positive group of the N_2 spectrum appears, together with the N, N^+ and N_2^+ spectra; with higher currents only the N and N^+ lines appear. The chief change in the Ne spectrum with increasing current is the gradual appearance of the Ne^+ lines. The effects of using various metals as electrodes are described. The bearing of the results on previous theories of high intensity discharges and spectrum formation is discussed. J. E. R.

5235. Reaction Kinetics in Electrical Discharges. S. S. Wassiljew. N. I. Kobosev and E. N. Erjemin. *Acta Physicochimica,* 5. 2. *pp.* 201–242, 1936. *In German.*—It is shown that the principles of chemical kinetics may be applied to reactions in the discharge. The kinetic schemes of the following reactions are determined and compared with the experimental data: Oxidation of nitrogen in the glow discharge, formation of ozone in the silent discharge, formation of atomic hydrogen, cracking of methane in the glow discharge. It is shown that the conditions of energy distribution during electrical activation are distinguished fundamentally from the conditions of thermal activation. In the above cases the kinetic constants are found to be invariant with respect to the change of velocity of passage of the gas through the discharge; they depend, however, on a whole series of other factors and above all on the work of discharge. It is also shown that when the parameter of the specific energy (the ratio of the work of discharge to the velocity of flow of the gas through the discharge) is introduced, it is possible to ascertain the influence of the work of discharge upon the velocity of the electrical activation processes. The paper is replete with mathematical analysis experimental data, diagrams and Bibliography. H. H. Ho.

5236. Chemical Reaction in Electric Discharges Part I. Statistical Theory of Discharge Reaction. K. G. Emeléus and R. W. Lunt. *Faraday Soc., Trans.* 32. *pp.* 1504–1512, *Oct.*, 1936.—The statistical theory of electron collision processes of the first kind has been developed with particular reference to the conditions found in the negative glow and the positive column. This leads to expressions for the current and energy efficiencies of such processes which show that these quantities have the properties frequently exhibited by the corresponding efficiencies for chemical reaction in these zones of a glow discharge. The nature of the relationship between the corresponding efficiencies is outlined. AUTHORS.

***5237. H.F. Discharge Tubes as Electrical Counters. S. C. Curran.** *Phil. Mag.* 22. *pp.* 599–616, *Oct.*, 1936.—Experiments on h.f. discharge tubes of various types are described. It is found that such tubes can be adapted to act very efficiently as electrical counters of good sensitivity and in which the " energy trigger ratio " is so large that a small loud-speaker may be included in the oscillator circuit to detect the counts as audible clicks. Three such discharge tubes and a suitable h.f. push-pull oscillator are described. A desirable feature of such counters is that there is no time constant which limits the rate of counting in other types.
C. J. B. C.

***5238. Amplifier for Coincidences of Proportional Wire Counters. G. Bernardini, D. Bocciarelli and F. Oppenheimer.** *Rev. Sci. Instruments*, 7. *pp.* 382–383, *Oct.*, 1936.—Details of an amplifier with small time constants, for the registration of proton coincidences by proportional wire counters. As the impulses of these counters are as large as 10^{-2} V, strict linear amplification is not essential and the arrangement is considerably simpler than the standard linear amplifier. While protons produce changes of 20–30 V on the grid of the thyratron, the α-rays from 45 mc. of Rn placed 5 cm. away and screened by 2cm. of Pb produced no increase in the background. F. C. C.

See also Abstracts 4938, 4942, 4943, 5086, 5087, 5105, 5132, 5133, 5149, 5185, 5283.

CONDUCTION IN SOLIDS AND LIQUIDS.

5239. Free Paths of Conduction Electrons. A. Papapetrou. *Zeits. f. Physik*, 102. 7–8. *pp.* 539–544, 1936.—Mathematical paper in which the author gives a simple method of determining the electrical conductivity, which in Bloch's theory necessitates the solution of an integral equation. R. L.

5240. Quantum Theory of the Electrical Conductivity of Alloys in the Superlattice State. T. Muto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers. No.* 653. *pp.* 99–120, *Sept.*, 1936. *In English.*—Nordheim's theory of alloy conductivity in the superlattice state is extended without assuming, as in Mott's treatment [see Abstract 3873 (1934)], random distribution of the component atoms among the lattice points of the crystal. The paper is mathematical, and the computation is carried out for the case of the typical superlattice alloy Cu_3Au, but can be easily generalised for other types. Results are in fair agreement with available experimental data. N. M. B.

5241. Electron Theory of Metals of Arbitrary Crystal Structure. M. Kohler. *Ann. d. Physik*, 27. 3. *pp.* 201–216, *Oct.*, 1936.—The equations of the electron theory of metals are formulated for a crystal of the most general structure, without specifying the dependence of the electron energy or of the mean free path on direction. The solutions of these equations are shown to have not only those symmetry properties which are required by the crystal symmetry, but also further simple properties. The electric and thermal conductivity are represented by symmetric tensors, even if the crystal symmetry does not rule out an antisymmetric term. The tensors entering into the thermoelectric laws may also contain antisymmetric parts. No restriction, beyond those required by the crysta symmetry, is found for the galvanomagnetic coefficients. R. P.

5242. Application of the Skin Effect to Investigation of Thin Metallic Layers. J. Goldfeld and N. I. Kobosev. *Acta Physicochimica*, 5. 2. *pp*. 243–270, 1936. *In German.*—A method of examining thin pellicles of metal upon metal depending on the skin effect and consisting in measurements of h.f. resistance is described. The method in the case of ferromagnetic metals amounts to a determination of μ of the pellicle. The variation of μ with the thickness of the layer, the current density and the time is interpreted from the standpoint of the structure of the pellicle on the basis of the theory of Becker and the data of Elenbaas and Peype. The method can be applied to the investigation of the kinetics of processes of crystallisation. The results obtained when a pellicle of Fe or Pt is heated to redness first in H_2 and then in air indicate the formation of an alloy. The upper limit of the velocity of diffusion of metal into metal is calculated. The applicability of the method to the investigation of the phenomena at the boundary surfaces of thin layers and the underlying substance is noted. The results from pellicles of Zn on Fe are explained on the supposition of the formation of an alloy. J. J. S.

5243. Electrical Properties of High Permeability Wires Carrying A.C. E. P. Harrison, G. L. Turney, H. Rowe and H. Gollop. *Roy. Soc., Proc.* 157*A*. *pp*. 451–479, *Nov*. 2, 1936.—The effects of a.c. of varying frequency and amplitude and of the application of external longitudinal fields on the effective resistance and inductance of Ni-Fe wires of high permeability are examined. The experimental results are interpreted by the classical theory of a.c. conduction on the assumption that the permeability is constant over the cross-section of the wire. Although the experimental results are generally in agreement with those deduced from theory, it is impossible to obtain numerical correlation between the magnetic properties of a wire deduced from impedance measurements and those measured by direct magnetic methods; also, the a.c. resistance or inductance of a wire cannot be predicted from its measured magnetic properties. The change of a.c. resistance caused by longitudinal fields of the order of the earth's field is so large as to suggest the use of the effect in the measurement or detection of small changes of field; the maximum change is brought about by a suitable heat treatment which must be determined experimentally. H. J. H. S.

5244. Resistance of Supraconductors. P. Grassmann. *Phys. Zeits*. 37. *pp*. 569–577, *Aug*. 15, 1936.—A method of measuring small resistances of the order of 10^{-15} ohm is described which is adapted to the measurement of the resistance of supraconductors. [See also Abstract 4356 (1935).] The method uses a ring-shaped supraconductor which is suspended in a steady magnetic field. A current of several amperes is induced in the ring and the decay of this current is studied by means of its interaction with the magnetic field. The resistance of a tin layer $6 \cdot 5\ \mu$ thick deposited on a copper ring was less than 10^{-14} of the resistance at room-temperature if the temperature of the ring was below the threshold value, and the resistance of a $3 \cdot 5\ \mu$ lead layer was less than 5×10^{-16} of the resistance at room-temperature. A lower limit for the number of electrons in a supraconductor is given. K. M. C.

5245. Specific Resistance of Nickel and its Alloys in the Annealed and Unannealed States. I. H. Thomas and R. M. Davies. *Phil. Mag.* 22. *pp.* 681–717, *Oct.*, 1936.—It is found that alloys can be divided into two categories, *viz.*, (1) in which the specific resistance is greater in the annealed specimens and (2) in which it is less. In all cases except ferry, the temperature coefficient of resistance (in the neighbourhood of room-temperature) is positive. The alloys also fall into two classes with respect to the temperature coefficients of the annealed and unannealed specimens, *viz.*, (1) where it is greater in the annealed condition and (2) where it is less. The ferromagnetic substances investigated in the neighbourhood of the Curie temperature were glow-ray, nickel-iron and monel. In connection with the relation between the specific resistances of the annealed and unannealed alloys, there appears to be no definite rule. The behaviour of the non-magnetic alloys, ferry, brightray, and 20 % Ni-Ag indicates that discontinuities in the resistance-temperature curve can occur without any apparent structural change so far as is indicated by the phase diagrams for these alloys. H. H. Ho.

5246. Electrical Conductivity of Thin Metallic Films. Part I. Rubidium on Pyrex Glass Surfaces. A. C. B. Lovell. *Roy. Soc., Proc.* 157*A*. *pp.* 311–330, *Nov.* 2, 1936.—The paper describes measurements of the resistivity of thin films of Rb deposited on cooled pyrex surfaces by a defined atomic beam. By employing high vacua and working under stringent conditions of purity with rigorous preheating of the surface, results consistent to within 2 or 3 % are obtained. It is shown that minute amounts of impurity on the substrate give rise to anomalous results of the type obtained by all previous workers on thin films, and an explanation of these anomalies is suggested. Conductivity is observed with films of only 1 Å in thickness. Normally, the films show a decay of conductivity with time after cessation of the deposition; but this decay decreases with increasing film thickness and with a lowering of the temperature of deposition. At the lowest temperature so far used (64° K.), this decay is inappreciable at a thickness of 25 Å. Films of thickness greater than 40 Å are so stable that their temperature coefficients are determined. The thickest film investigated (90 Å) is still invisible but obeys Ohm's law up to current densities of at least 10^6 A/cm^2. The resistivity of a 40 Å film is 10 times greater than that of the bulk metal, whereas previously the lowest resistivity obtained in metallic films of this thickness has been 10,000 times greater. The variation of resistivity with thickness and temperature for these stable films agrees with a formula derived by simple quantum mechanical treatment. The decay of conductivity is discussed in terms of a break-up of the film under surface tension forces. AUTHOR.

5247. Conductance of Salts and Dissociation Constant of Acetic Acid in Deuterium Oxide. V. K. La Mer and J. P. Chittum. *Am. Chem. Soc., J.* 58. *pp.* 1642–1644, *Sept.*, 1936.—The Walden constant $= \Lambda_0 \eta$ increases (linearly) by $1 \cdot 93$ % on passing from H_2O to D_2O for both potassium acetate and potassium chloride. With this equation and the rule $[\Lambda_c/\Lambda_0]_{H_2O} = [\Lambda_c/\Lambda_0]_{D_2O}$, which follows from the Onsager equation and the Walden rule, it is shown how the dissociation constants of weak acids in D_2O may be calculated with satisfactory accuracy from a limited amount of conductance data. *K′* (acetic acid) equals $0\cdot55 \times 10^{-5}$ in pure D_2O, and exhibits a marked negative deviation (10 %) from linearity on passing from H_2O to D_2O. AUTHORS.

5248. H.F. Conductivity of Congo Red and Congo Blue Sols. G. Schmid and A. V. Erkkila. *Zeits. f. Elektrochem.* 42. *pp.* 737–741, *Oct.*, 1936.—The increase in h.f. conductivity postulated by Debye and Falkenhagen should be enhanced in the case of colloids, owing to their electric charge. Actual increases of 29·2–31·7 % for Congo blue, and 6·2–11·8 % for Congo red, according to concentration, are observed by Deubner's method, for $\lambda = 3\cdot60$ m. D. R. H.

5249. Conductance and Dielectric Constant of Liquid Hydrogen Chloride. G. Glockler and R. E. Peck. *J. Chem. Phys.* 4. *pp.* 658–660, *Oct.*, 1936.—Liquid HCl has a specific electrical conductivity of $0\cdot35 \times 10^{-8}$ reciprocal ohms at − 85° C. The temperature coefficient is negative: $-0\cdot65 \times 10^{-10}$ in the range from − 84° C. to − 64° C. The molecular conductivity at infinite dilution is estimated to be 184 (− 85° C.) and 192 (− 53° C.). The ionisation constant is $0\cdot083 \times 10^{-16}$ at − 78° C. and $0\cdot051 \times 10^{-16}$ at − 68° C. The change in heat content of the ionisation reaction is $(x + y + 2)HCl \rightarrow (H_2Cl\cdot HCl_x)^+ + (Cl\cdot HCl_y)^-$. $\Delta H_{195} \doteq -3500$ cal. AUTHORS.

5250. Measurement of Small Conductivities and of Dipole Loss with Long Waves. C. Schreck. *Ann. d. Physik*, 27. 3. *pp.* 261–284, *Oct.*, 1936.—Measurements, by a barretter arrangement, at wave-lengths from 18,000 to 170 m. of conductivity and dielectric constant of various organic solutions. Results are given for benzol-alcohol mixtures, for various alcohols and sugars, and for glycerin at various temperatures. W. H. W.

***5251. Principles of Conductivity Measurement. K. Fischer.** *Zeits. f. Instrumentenk.* 56. *pp.* 411–422, *Oct.*, 1936.—A general account of the usual methods of measuring conductivity derived from Kohlrausch's classical method. A table is given of makers (German) and prices of instruments likely to be useful in such methods. N. F. A.

5252. Electrical Conductivity of Barium Chloride and its Variation with Temperature. V. J. Jehu. *Phys. Soc., Proc.* 48. *pp.* 850–856, *Nov.* 1, 1936.—The electrolytic conductances of aqueous solutions of barium chloride have been measured over a wide range of concentration and temperature. The equivalent conductivities at infinite dilution have been found by the method of Shedlovsky, and a formula connecting conductivity and temperature is given. AUTHOR.

See also Abstracts 5029, 5181, 5262.

DIELECTRICS AND CAPACITANCE.

5253. Carbon Valency Angle and Dipole Induction in Benzyl Compounds. F. C. Frank. *Chem. Soc., J. pp.* 1324–1327, *Sept.*, 1936.—The author demonstrates that dipole-moment data give quite consistent results in stereochemical calculations if due allowance be made for complicating influences, and he discusses initially the following solvent effects: (1) A solvation moment, due to dipoles induced in the solvent by primary dipoles in the solute [see Abstract 4673 (1935)]. (2) A solvation polarisation, due to the change of solvation moment when solute molecules are displaced relative to solvent. (3) A negative solvation polarisation arising from dielectric "saturation" in polar solvents, which are rightly avoided. (4) Further corrections to the Clausius-Mossotti equations necessary in the case of anisotropically polarisable molecules, or when the volume refractivities of solvent and polar solute differ. All the evidence indicates that only minor additional errors arise under these heads. The valency angle of aliphatic C is calculated to be 110°, the apparent angle by Smyth and Walls' method being 119°. H. H. Ho.

5254. Calculation of Polarisation Ellipsoids of Molecules. T. Neugebauer. *Zeits. f. Physik*, 102. 5–6. *pp.* 305–316, 1936.—The change in polarisability of an ion due to external influences can be calculated by a simplified method, but the results give a value for the molar refraction of HCl which is 8 % too low, whilst the calculated polarisabilities of the molecule parallel and perpendicular to the long axis are also out of harmony with the results of Kerr-constant measurements. The discrepancy is due to the application of methods of calculation for spherical-symmetrical ions to the case of non-spherical charge distribution in molecules containing many electrons. To account for this, new terms must be introduced into the quantum-mechanical interpretation of the classical Silberstein theory. C. B. A.

5255. Molecular Rotation in Solids. C. P. Smyth. *Am. Phil. Soc., Proc.* 76. 4. *pp.* 485–489, 1936.—A simple account is given of the evidence for molecular rotation in solids, with special reference to the variation of dielectric constant with temperature. C. B. A.

5256. Non-Rotation of Molecules in a Number of Solids. S. A. McNeight and C. P. Smyth. *Am. Chem. Soc., J.* 58. *pp.* 1718–1722, *Sept.*, 1936.—The dielectric constants of solid methylamine, ethyl ether, acetone, benzophenone and succinic acid are measured over a wide range of temperature and frequency to investigate the possibility of rotation of their molecules. Although the molecular shape of methylamine is such that rotation might well occur and although ether shows different freezing and melting points, benzophenone shows polymorphism, and acetone and succinic acid show humps in their specific heat-temperature curves, no molecular rotation has been found in these solids. The low dielectric constants of solid methyl chloride, bromide and iodide, methylene chloride and chloroform are used to show that, in the solid state, their molecules cannot rotate around any axes perpendicular to the axis of molecular symmetry. AUTHORS.

5257. Molecular Rotation in Solid Arsine and Other Hydrides. C. P. Smyth and S. A. McNeight. *Am. Chem. Soc., J.* 58. *pp.* 1723–1728, *Sept.*, 1936.—The dielectric constants and specific conductances of solid HCN and H_2Se are measured from liquid-air temperature to the regions of the melting point and those of AsH_3 are measured from liquid hydrogen temperature to the region of the boiling point over a frequency range from 0·5 to 50 kc. No molecular rotation is found in solid HCN while the molecule rotates freely in the selenide even at liquid air temperature. The arsine molecule rotates freely down to 32·1° K. where a transition sets in, which is not complete at 20·5° K. and is accompanied by some anomalous dispersion. The molecules of the hydrides tend to rotate more readily the smaller their dipole moments. AUTHORS.

5258. Molecular Rotation in Solid Aliphatic Alcohols. C. P. Smyth and S. A. McNeight. *Am. Chem. Soc., J.* 58. *pp.* 1597–1600, *Sept.*, 1936.—The dielectric constants of solid methyl, *t*-butyl and *n*-octyl alcohols have been measured from liquid air temperatures up to the melting point in order to investigate the question of dipole rotation in the solid state. The high dielectric constant of methyl alcohol just below the melting point, dropping to a low value at a transition temperature 159·9° K., gives evidence of dipole rotation in this region. The absence of dipole rotation in solid *t*-butyl and *n*-octyl alcohols and the failure of specific heat measurements to show transitions in many other alcohols, indicate that the hydroxyl group does not rotate inside the molecule, but that the entire methyl alcohol molecule rotates above the transition point. AUTHORS.

5259. Evidence of Wave-Mechanical Resonance in the Carboxylic Ester and the Lactone Group, from Electric Dipole Moments. R. J. B. Marsden and L. E. Sutton. *Chem. Soc., J. pp.* 1383–1390, *Sept.*, 1936.—The calculated moments (in Debye units) for the two extreme possible configurations of the carboxylic ester group are 1·53 for the *trans*- (alkyl groups as far apart as possible) and 3·53 for the *cis*- (alkyl groups as near as possible). From these values, and the facts that the moment of γ-butyrolactone is 4·12, and that the lactone has the *cis*-configuration, it is now proven that the esters must have the *trans*-configuration. If the very definite *trans*-fixation observed in esters were due to electrostatic forces alone, the moment of an ε-lactone should be approximately 2·7; if, however, it were due mainly to stiffening produced by resonance with another structure, the moment should be at least equal to that of a γ-lactone. That of βζ-dimethyl-ε-octolactone is slightly larger, 4·33, and thus supports the latter explanation. The evidence which the moments of the phenolic and benzoic esters afford of resonance interaction with the benzene ring is discussed, and shown to support the predictions of the Robinson-Ingold theories. The configuration of the nitrous esters is discussed. The available experimental evidence is not decisive. AUTHORS.

5260. Dielectric Constant of Dilute Solutions. M. Beauvilain. *Ann. de Physique*, 6. *pp.* 502–560, *Oct.*, 1936.—An account of measurements of the variation, with concentration up to 0·0015 *N*, of dielectric constant of aqueous solutions of a large number of salts and of solutions of KCl in several organic solvents, and their mixtures with water. The salts used are given in the original on p. 548, the solvents on p. 549, and a comparison of the result obtained with those given by various authorities on p. 556. W. H. W.

***5261. Force Method of Determining the Dielectric Capacity of Liquids. W. J. Shutt and H. Rogan.** *Roy. Soc., Proc.* 157*A*. *pp.* 359–372, *Nov.* 2, 1936.—The Fürth force method for the determination of dielectric constant is modified and the new apparatus is described in detail. The method is now considered to be reliable to within an accuracy of ± 0·2 % for solutions of electrolytes having conductivities less than 0·005 mho. The occurrence of electrolytic polarisation of the electrode surfaces is discussed. The effect of frequency of applied alternating field is tested over a range of from 50 to 2000 ∼ and, with a well platinised ellipsoid, such variation of frequency is found to be without influence upon the observed dielectric constant of dilute electrolytes. The apparatus is tested with aqueous solutions which have well-defined dielectric constants. Figures are given for the dielectric constants of solutions of LiCl, NaCl, and KCl up to a concentration of about 0·04 *N*, of HCl up to 0·01 *N*, and of NaOH to 0·02 *N*. All these electrolytes affect the dielectric constant of water to a comparatively small extent; a lowering of only about 4 % is observed with the strongest solutions studied. The dielectric constant falls continuously with increasing concentration of electrolyte over the range of concentration used. The discrepancies between the experimental results and the Debye-Falkenhagen theory are discussed briefly. AUTHORS.

***5262. Current, Breakdown Voltage, and Ultrasonic Vibrations in Liquid Dielectrics. W. Meyer.** *Zeits. f. Physik,* 102. 5–6. *pp.* 279–304, 1936.—Apparatus is developed and described for the investigation of the conductivity and breakdown voltage of liquid dielectrics under the action of ultrasonic vibrations. One of the electrodes vibrates with the surface of a quartz plate which is in resonance with an oscillatory circuit. An increase in conductivity results, depending on the nature of the surface of the vibrating electrode; and at the same time there is a considerable decrease in the value of the breakdown voltage. Values are given of the variations of conductivity and breakdown voltage for a number of different liquids. L. E.

***5263. Measurement of H.F. Electrical Field-Strengths. S. J. Braude.** *Phys. Zeits. d. Sowjetunion,* 10. 1. *pp.* 106–110, 1936. *In German.*—The author describes a method for the measurement of field-strength for ultra-short and especially decimetre waves. Malsch and Keutner's investigations of alcohols [see Abstract 2720 (1935)] to serve as indicators of field-strength are examined and confirmed, and the author's previous use of hexyl alcohol is justified. Details of the apparatus employed are included. H. H. Ho.

5264. H.F. Losses in Polar Solutions. G. Martin. *Phys. Zeits.* 37. *pp.* 665–677, *Oct.* 1, 1936.—Describes measurements of h.f. losses at 3·82 m. wave-length. The losses in three dichlorbenzenes are found to be proportional to the square of the dipole moments. The losses obtained by extrapolation to infinite dilution for three alcohols—C_3H_7OH, $C_8H_{17}OH$ and $C_{16}H_{33}OH$—are proportional to the number of the C-atoms, but a fourth alcohol, $C_6H_{13}OH$, is an exception to this rule. Measurements on solutions of *o*-dichlorbenzene in non-polar solvents and also on the above alcohols show that the linear relation between relaxation time and viscosity given by Stokes' law holds only if we consider the molecular—and not the macroscopic—viscosity. In non-polar liquids, the molecular viscosity appears to be a function of macroscopic viscosity and molecular volume. E. R.

See also Abstracts 5029, 5143, 5190, 5249, 5250.

ELECTROCHEMISTRY.

5265. Reactions in the Lead Accumulator. K. Kinoshita. *Chem. Soc., Japan, Bull.* 11. *pp.* 504–512, *Aug.*, 1936.—Changes in mass of 1 A.h. pasted plates, 2·0 × 9·6 × 0·3 cm., discharged at 0·25 A, are observed by direct weighing while suspended in the electrolyte thermostated at 25°C., at hourly intervals. Results do not agree well either with the $PbSO_4 + PbSO_4$ theory, or with the $PbO_2 + Pb_2SO_4$ theory. Alteration in concentration or viscosity of the acid has little effect, but with addition of about 25 % glycerol, the cell voltage falls to 1 V in a few minutes. The effect of gas bubbles in the electrode pores is considered to be small. If corrections for density differences are applied the author's results support the $2PbSO_4$ theory. D. R. H.

5266. Overvoltage of Hydrogen at High Current Densities. B. Kabanow. *Acta Physicochimica,* 5. 2. *pp.* 193–200, 1936. *In German.*—A method for the investigation of electrode reactions at high current densities is developed. The method is applicable to current densities up to 100 A/cm^2. The hydrogen overvoltage is measured at high current densities on Pt, Ag, and Ag amalgam in 5-*N* H_2SO_4 and HCl. It is found that the overvoltage follows a linear relationship to the logarithm of the current density up to an overvoltage of 1·5 V. F. J. B.

5267. Hydrogen Overvoltage and the Reversible Hydrogen Electrode. J. A. V. Butler. *Roy. Soc., Proc.* 157*A. pp.* 423–433, *Nov.* 2, 1936.—In the discharge of H-ions at metallic kathodes adsorbed H_2 may be formed at a lower potential than "free" H_2 liberated according to Gurney's mechanism. There is a p.d. at which the rates of transfer of H-ions to adsorption positions and the reverse are equal, and it is shown that in favourable cases the activation energy of the reversible transfer is sufficiently low to give rise to a practically reversible electrode. H_2 can, however, only be continuously evolved by this process with currents which are less than the rate of desorption of H_2 from a saturated surface, and with greater currents an alternative mechanism must come into action. It is suggested that at high overvoltage electrodes the rate of desorption is small, and H_2 is formed by Gurney's or some similar mechanism. AUTHOR.

5268. Mobility of Copper Ions in Rock-Salt. S. A. Arzybyschew and N. B. Borissow. *Phys. Zeits. d. Sowjetunion,* 10. 1. *pp.* 44–55, 1936. *In German.*—The mobility of Cu ions in rock-salt at temperatures between 540° C. and 750° C. is investigated, with consideration of the influence of diffusion. The mobility has the value 5·98 $e^{-12600/\tau}$ cm^2. sec.$^{-1}$/volt. The minimum concentration of the Cu, which can be found by the method of electron colouring (2×10^{-7} gm. Cu per gm. salt) is determined, and the influence of the ionic concentration on the mobility is investigated. [See following Abstract.] J. J. S.

5269. Diffusion of Copper in Rock-Salt. S. A. Arzybyschew. *Phys. Zeits. d. Sowjetunion,* 10. 1. *pp.* 56–66, 1936. *In German.*—The diffusion of Cu in rock-salt at different temperatures from 590° C. to 740° C. is determined. The coefficient of diffusion is found to be $D = 1{\cdot}07$ $e^{-13100/\tau}$ cm^2./sec. [See preceding Abstract.] J. J. S.

5270. Normal Potential of Ag-AgBr Electrode. B. B. Owen and Louise Foering. *Am. Chem. Soc., J.* 58. *pp.* 1575–1577, *Sept.,* 1936.—The normal electrode potential of the Ag-AgBr (fused) electrode has been determined from 5 to 40° by comparison with the Ag-AgCl electrode in borax solutions without liquid junctions. The reliability of the method is indicated by satisfactory agreement with results obtained with similar electrodes in HBr solutions. By using materials from a variety of sources and subjected to different degrees of purification, it was shown that the Ag-AgBr (fused) electrode is highly reproducible. [See also Abstract 4688 (1935).] AUTHORS.

5271. Periodic Potential Oscillations of Iron in Chromic-Sulphuric Acid. Part III. M. Karschulin. *Zeits. f. Elektrochem.* 42. *pp.* 722–729, *Oct.,* 1936.—Earlier work is continued [Abstract 4331 (1934)]. Iron is shown to pass into solution in chromic-sulphuric acid as ferrous ions, which are subsequently oxidised to the ferric state. The negative potential oscillation is due to the formation of the ferrous ions and the oxidation to ferric ions not taking place simultaneously, owing to the diffusion layer present on the surface of the iron. The potential limit of the oscillations is dependent upon the concentration of the ferrous ions, on the one hand, and the ratio Fe^{++}/Fe^{+++} at the surface of the iron, on the other. The positive potential oscillation is due to decrease of the H-ion concentration at the iron surface when the concentration of the chromic acid is sufficiently great. F. J. B.

5272. Corrections for Liquid-Junction Potentials. W. J. Hamer and S. F. Acree. *Bureau of Standards, J. of Research,* 17. *pp.* 605–613, *Oct.,* 1936.—Determinations are made of the errors in pH, dissociation constants, " salting-out " coefficients, ionic strength, ionic concentrations, and hydrogen-ion activity coefficients arising from neglect of or partial corrections for the potential of the liquid junction between saturated potassium chloride (4·1 N KCl – HgCl electrode) and sodium malonate buffer solutions. The experimental data are obtained in the electrometric titration of 0·1 M malonic acid with 0·1007 N sodium hydroxide. It is shown that partial corrections produce a larger error in these quantities than no corrections. An error as small as 0·3 % in pH may produce a change as large as 23 % in dissociation constants. AUTHORS.

***5273. New Uses for Glass Electrode. F. Müller and W. Dürichen.** *Zeits. f. Elektrochem.* 42. *pp.* 730–732, *Oct.,* 1936.—New applications of the glass electrode in combination with an electron tube potentiometer are described. The use of the apparatus for the determination of pH is indicated, and a means of automatically controlling pH by a photoelectric galvanometer intensifier is developed. F. J. B.

***5274. Volta's Pile Constructed Entirely of Electrolytes. A. Thiel.** *Zeits. f. Elektrochem.* 42. *pp.* 742–744, *Oct.,* 1936.—Cardboard discs steeped respectively in 35 % H_2SO_4, 30 % $Na\bar{A}$, 20 % LiCl solutions, are built up in that order into a pile 35 cm. high, the upper and lower discs being soaked in saturated KCl solution to which a little $ZnCl_2$ is added. Connections are made by accumulator acid (H_2SO_4, Δ 1·18) carried in glass tubes or absorbed in cotton wool. The existence of a current on short-circuiting may be demonstrated by a small hanging magnet or by a high-resistance galvanometer. As much as 1·5 V may be generated and 30 mA. can be maintained over a long period. The continuous twitching of a frog's leg as a lecture experiment is described. D. R. H.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

5275. Use of Complex Riemannian Geometry in the Theory of the Electron. U. Kakinuma. *Inst. Phys. and Chem, Research, Tokyo, Sci. Papers. No.* 652. *pp.* 83–98, *Sept.,* 1936. *In English.*—It is shown how the author's relativistic theory [see Abstract 2370 (1936)] of the field-equations for the microscopic space within the electron can be based on the Riemannian geometry of a complex space provided that a linear, instead of a quadratic, differential form is taken as fundamental. Dirac's equations for the electron can be generalised to curved spaces by this method. G. C. McV.

5276. Properties of an Electron which Rolls without Slipping. T. V. Ionescu. *Comptes Rendus,* 203. *pp.* 537–539, *Sept.* 14, 1936.—The properties of an electron are calculated, supposing that it moves as if it were attached to the surface of a cylinder which rolls without slipping. The wave-length associated with the electron, the kinetic moment of spin, the magnetic moment of the spinning electron, etc., are calculated. C. J. B. C.

5277. Validity of X-Ray Crystal Methods of Determining the Electronic Charge. J. W. M. DuMond and V. L. Bollman. *Phys. Rev.* 50. *pp.* 524–537, *Sept.* 15, 1936.—The determination of *e* from measurements of X-ray diffraction angles and the density of crystals has been criticised on the ground that while density measurements are averages of relatively large volumes, the X-rays are diffracted from a surface layer as determined by "extinction" only about 4×10^{-4} cm. thick. The present work with extremely finely powdered calcite samples, whose density is determined with a pyknometer, leaves no ground for criticism and places X-ray determinations of *e* on a firm experimental foundation. The value obtained for *e* is $4 \cdot 799 \pm 0 \cdot 007$ e.s.u. based on the scale of ruled grating wave-lengths in which CuKα, has a wave-length of $1 \cdot 5406 \times 10^{-8}$ cm. (Bearden.) Several new crystal diffraction effects are described. Agreement to 1 part in 6000 between Bragg and Laue diffraction angles is established for two different sets of Miller indices in macroscopic calcite.
C. J. B. C.

5278. Fundamental Physical Constants. W. N. Bond. *Phil. Mag.* 22. *pp.* 624–632, *Oct.*, 1936.—Estimates of the numerical values of fundamental physical constants are deduced from Eddington's theories concerning M/m, $hc/2\pi e^2$ and the universal gravitational constant, G. Confirmatory experimental evidence is given, and the remaining discrepancies are pointed out. The paper concludes with tables of data and deductions and a fairly extensive Bibliography. AUTHOR.

***5279. Optical Demonstration of Geometrical Features of Electron Diffraction Photographs. W. G. Burgers and J. J. A. P. van Amstel.** *Zeits. f. Krist.* 95. *pp.* 54–73, *Oct.*, 1936. *In English.*—An arrangement is described in which the effective part of the sphere of reflection is represented by an illuminated plane, which is possible on account of the short wave-length of 30–50 kV electrons. Appropriate models of the reciprocal lattices are then introduced, and an audience is enabled to picture directly the effect of electronic diffraction. F. I. G. R.

5280. Collision of Neutron and Proton. P. M. Morse, J. B. Fisk and L. I. Schiff. *Phys. Rev.* 50. *pp.* 748–754, *Oct.* 15, 1936.—An exact solution is found for the bound and free states of a neutron-proton pair under the influence of a potential field $-D[2 \exp (2/r_0)(r_1 - r) - \exp (4/r_0)(r_1 - r)]$, where the field can be of the Majorana type and may depend on the spin coupling. Values of binding energy (for the deuteron), of elastic cross-section, of capture cross-section and of cross-section for the photoelectric disintegration of the bound state are computed for a wide range of the parameters used. Curves of the results are shown. In order to correspond to the experimental values of binding energy and of elastic cross-section for slow neutrons, the value of D for the singlet state, D_s, must be made about one-half that for the triplet state, D_t. Separate calculations are made, assuming a bound singlet state, and assuming no bound singlet state. When this is done, the capture and photoelectric cross-sections check the experimental values fairly well, the computed results being practically independent of r_0 and r_1 as long as these parameters are less than 6×10^{-13} cm. Thus a proper choice of two relations between the four parameters D_s, D_t, r_0, r_1, gives agreement with four different experimental values; the other two relations needed to determine all four parameters will require further experimental data for their determination. AUTHORS.

5281. Anomalous Scattering of Protons in Light Elements. E. G. Dymond. *Roy. Soc., Proc.* 157*A. pp.* 302–310, *Nov.* 2, 1936.—Measurements are made of the scattering of protons, 130 to 190 ekV in energy, from thin films of Ag, Al, B and Be. The results are given in terms of the ratio of the scattering in Ag and in the other elements, as it may be assumed that Ag scatters classically. It is found that at 190 ekV in Al there is an excess scattering of 17·6 ± 1·8 % at 150° and 9·7 ± 1·0 % at 110°, and in Be 4·4 ± 1·6 % at 150° and 13·5 ± 1·0 % at 110°. Within the limits of probable error the scattering in B is normal. To account for these results it is necessary to assume that existence of resonance D levels for the proton in Al and Be in the neighbourhood of 200 ekV. These levels are considerably lower in energy than any that have been previously found by other means. AUTHOR.

5282. Correlation between Secondary Electron Emission with Photoelectric Sensitivity and the Thermionic Effect. A. Dobroljubski. *Zeits. f. Physik,* 102. 9–10. *pp.* 626–628, 1936.—From research on the secondary electron emission from the layers Cs — Cs_2O — Ag, Cs — Cs_2O — Ni and Cs — Cs_2O — Cu it has been found that the magnitude of the coefficient of secondary electron emission for electron bombardment of these layers is determined principally by their integral sensitivity in the u.v. region. Kluge and Suhrmann have shown that this integral sensitivity in the u.v. is determined by the layer below the oxide of the alkali metal and hence it should be possible to obtain layers without photoelectric sensitivity in the visible and infra-red regions, but with normal secondary electron emission. Measurements were made of the photoelectric and of the dynatron sensitivity of the layer Cs — Cs_2O — Ag at different stages during evacuation. The photoelectric sensitivity for white light was found to increase only slightly, but the coefficient of secondary electron emission reached a maximum and then slowly fell again towards the stationary value. The absence of any relation between the dynatron sensitivity and the photoelectric sensitivity for white light was also noted for the layers Ag_2O — Ag and Cs — Ag_2O — Ag. The layer Ag_2O — Ag was found to have, unlike the Cs layer, no appreciable photoelectric sensitivity and it has a coefficient of secondary electron emission of 1·2 at 150 V, which value was also obtained for the Cs layer. The results are briefly discussed in their relation to thermionic effects. A. W.

5283. Secondary Emission from Copper due to Slow Positive Ions of Argon. F. L. Jones and W. H. Willott. *Phys. Soc., Proc.* 48. *pp.* 830–838, *Nov.* 1, 1936.—The dependence of the secondary emission from the kathode on the energies of the impinging positive ions is of importance in the mechanism of the corona, or asymmetric, discharge through gases. In particular, it is important to find whether positive ions are able to liberate electrons from an electrode on to which they drift when their mean energy of agitation is no greater than that of the atoms of the gas through which they move. This paper describes experiments performed with positive ions of A moving in that gas under weak electric fields in order to measure the secondary emission produced at a Cu kathode. No secondary emission was detected when the electric intensity Z was less than 20 V/cm. and Z/p was less than 40, but the secondary emission attained a value of about 1·1 % when the electric field was increased above 60 V/cm. corresponding to values of Z/p greater than 100. This result is compared with those previously obtained with H and He ions under similar conditions. AUTHORS.

5284. Acceleration of Electrons by a Variable Electromagnetic Field. W. W. Jassinsky. *Arch. f. Elektrot.* 30. *pp.* 590–603, *Sept.* 8, 1936. *R.G.E.* 40. *pp.* 355–365, *Sept.* 19, 1936.—A mathematical analysis leads to the laws governing the movement of an electron under the action of a magnetic field, which can be either variable or almost stationary. The results with and without an additional radial electrostatic field are also given. The trajectory of an electron under these conditions is shown to be the resultant of four logarithmic spirals. In the case when a radial electric field of a given value is used, a unique stable electronic orbit is shown to exist, thus contradicting the result of Hall and Langmuir. The analysis shows that electrons of very great velocity can be obtained by using the circular electric field arising from the variations of the magnetic field, and an additional radial electric field. The approximations necessary in the theory and their degree of validity are dealt with. G. O. B.

5285. Electron-Optical Pictures of Diatoms with Magnetic Electron Microscope. F. Krause. *Zeits. f. Physik,* 102. 5–6. *pp.* 417–422, 1936.—A number of electron-optical photographs (electron-micrograms) of diatoms are shown with the object of demonstrating the resolving power of a magnetic electron microscope. The diatoms are mounted on Mo net and a beam of 50 kV-electrons is used to produce transmission pictures of the diatom. Structures of the order of $0{\cdot}26\ \mu$ are clearly resolved. The aperture of the magnetic lens is estimated at $0{\cdot}02$; this gives an estimated resolving limit of $0{\cdot}274 \times 10^{-3}\ \mu$. H. J. H. S.

5286. Calculation of Electron Optical Constants as Proper Value Problem. P. Funk and W. Glaser. *Zeits. f. Physik,* 102. 9–10. *pp.* 603–610, 1936.—An eigenvalue parameter is introduced into the differential equation for the passage of a paraxial electron beam through an electromagnetic electron-optical lens field and the calculation of the cardinal points of the lens is carried out by application of Ritz's method for approximate determination of eigenvalues. J. E. K.

***5287. Divided Lens for Electrostatic Lens Systems. J. Hennig.** *Zeits. f. Physik,* 102. 9–10. *pp.* 629–632, 1936.—A definition is given of a " simple " lens and it is shown how a lens system may be split up into a number of such lenses. It is suggested that, if each component is corrected, the whole system is corrected. In illustration, the weak " einzellinse " of minimum spherical aberration described by Scherzer [see Abstract 3864 (1936)] is considered. H. J. H. S.

5288. Theory of Image Defects in Electron-Optical Systems. J. Gratsiatos. *Zeits. f. Physik,* 102. 9–10. *pp.* 641–651, 1936.—Two methods have already been described for obtaining the deviations from the Gaussian ray paths, one by Glaser, who used the Seidel eikonal method and the other by Scherzer, who deduced the deviations from the equations of the electron paths. A new method using point eikonals is now suggested. The calculations lead to expressions which are similar to those given by the former methods. H. J. H. S.

***5289. Construction of Electron Lenses with Resistance Windings. M. v. Ardenne.** *Arch. f. Elektrot.* 30. *pp.* 623–624, *Sept.* 8, 1936.—An electrostatic electron lens is described in which the rise of potential along the axis is influenced by variation of the height of a high-resistance winding on the inside of an insulating cylinder. The resistance may be deposited in a close spiral on the inside of a glass tube and may have a valve of the order of 1 to 10 MΩ. A. W.

5290. Photographic Recording with Braun Tube. C. Bachem. *Phys. Zeits.* 37. *pp.* 650–655, *Sept.* 15, 1936.—A formula is derived giving the greatest writing speed with which it is possible to obtain a photographic record of the fluorescent screen of a Braun tube by an external camera in terms of the geometrical and optical constants of the arrangement and of the intensity of the spot. A correcting factor for the light lost in the recording system is deduced and an approximate value for it is obtained for a number of lenses commonly used. The various factors concerned are experimentally examined and reference is made to the writing speed nomograms of v. Ardenne. With modern types of Braun tube it is possible to obtain oscillograms with writing speeds up to 17 km./sec., with an operating voltage of 4 kV. and a camera lens of aperture f/3.5. **Errata,** *ibid. p.* 736, *Oct.* 15, 1936. H. J. H. S.

See also Abstracts 4962, 4963, 4973, 4974, 4975, 5079, 5136, 5310, 5319.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

5291. Thermomagnetic E.M.F. in Ferromagnetic Alloys. N. Yamanaka. *Tôhoku Univ., Sci. Reports,* 25. *pp.* 174–183, *July,* 1936. *In English. Report No.* 369 *from the Research Inst. for Iron, Steel and other Metals.*—It has been ascertained that the thermomagnetic e.m.f., discovered by Gerlach [see Abstract 261 (1931)] appears not only in nickel and iron, but also in other ferromagnetic alloys, and its dependency on the magnetic field as well as on the temperature gradient is fully investigated. AUTHOR.

See also Abstract 4243.

MAGNETISM AND ELECTROMAGNETISM.

5292. Time Lag in the Magnetisation of Soft Iron. J. Ôkubo and N. Yamanaka. *Tôhoku Univ., Sci. Reports,* 25. *pp.* 163–173, *July,* 1936. *In English. Report No.* 368 *from the Research Inst. for Iron, Steel and other Metals.*—The transient process of magnetic induction in ferromagnetic substances after sudden removal of the applied field was observed in the upper portion of the hysteresis loop. The substances tested were soft Fe, and Fe-Si-Al alloys. The magnetic permeability of these substances remained nearly constant during the change of magnetic induction in the field of observation. In order to minimise the complications arising from the demagnetising field, the experiment was made on the substances in the form of the anchor ring. Thus the conditions required by Wwendensky's eddy current theory are satisfied. The results obtained were in good agreement with that which follows from his theory of the time lag. For the time lag in the interior layers of the substance, the observations were carried out in the air gap cut in the anchor ring. This gap introduces complications not only in the magnetic induction but also in the change of induction. Therefore, it is difficult to account for the observed results theoretically, but at least, they were qualitatively in agreement with those to be expected from Wwendensky's eddy current theory of the time lag. AUTHORS.

5293. Discontinuous Change in Magnetisation in Ferromagnetic Substances. K. Murakawa. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 380–401, *Aug.,* 1936. *In English.*—The reversal process in Fe is investigated in detail with the aid of the Barkhausen noise. The material tested consisted of polycrystalline Fe wires, a single crystal of Fe, and Si-Fe wires. The method of testing is to amplify the e.m.f. generated by the specimen in a coil by the gradual approach of a horse-shoe magnet which reverses the magnetisation of the wire. The amplified e.m.f. is recorded by an oscillograph. Oscillograms are shown in which the deflections due to reversal of magnetisation have the form of groups of sharp peaks, and sometimes single peaks. The peak group can be split up into single peaks, all of similar form, differing only in height. The integrated area within the peak gives the flux change due to reversal of magnetisation. The presence of peak groups is regarded as indicating an internal obstacle to the propagation of the reversal. The reversal process is pictured and described. G. E. A.

***5294. Ferromagnetism of Iron Alloys. M. Fallot.** *Ann. de Physique*, 6. *pp.* 305–387, *Sept.*, 1936.—The author has verified by experiment the law of variation of saturation intensity with temperature down to 20·4 K, *viz.* $\sigma_T = \sigma_0 [1 - C (T/\theta)^{3/2}]$ [see Abstract **2925** (1930)], and states the conditions of application of the law. An apparatus was constructed for the liquefaction of small quantities of H_2 for use in the research, also a recording apparatus for the determination of ferromagnetic Curie points. Several series of iron alloys were prepared, their mean atomic moments determined, and also their Curie points. In Fe alloyed with Si, Al, Cr and Mn, this temperature was lowered; with V it was raised, and in alloys with Au, Sn and Pt no effect was observed. The mean atomic moment decreases linearly with the addition of the second metal except for Fe-Al containing 13 to 26 % Al. The moment depends on the stranger atoms which surround the Fe atom in the lattice. Magnetic properties present singular points, in their variation with the added metal, which reveal facts relating to the atomic structure of the alloys. G. E. A.

5295. Magnetic Behaviour of Nickel at Temperatures up to the Curie Point. W. Schnabl. *Ann. d. Physik*, 27. 2. *pp.* 169–185, *Sept.*, 1936.—Experiments were made on the effect of the frequency of an alternating field on the magnetic losses of Ni wires at temperatures between 20° and 326° C. A definite frequency effect was noted in the losses for a frequency of 50, and the effect is more marked at 500∼. The decrease in permeability and increase in losses with increase of frequency are not explainable in terms of eddy current losses. At the higher temperatures the effect diminishes rapidly to the disappearing point. G. E. A.

5296. Effect of Elastic Strain on the A.C. Magnetisation Curve. H. Littmann. *Ann. d. Physik*, 27. 2. *pp.* 186–200, *Sept.*, 1936.—The effects of heat, tension and torsion on the magnetisation curves of wires of nickel, nickel-iron and permalloy were investigated for longitudinal (L) and circular (C) fields, and the following results were obtained. The displacement of the magnetisation curve in the direction of greater induction is not a consequence of magnetic anisotropy brought about by heating. Repetition of the heating process is incapable of freeing the material entirely from internal elastic strain. The effect of tension on the L and C magnetisations may be explained by means of Becker's theory. The same holds for the observed effects of torsion. Tension causes a decrease of μ for L-magnetised Ni and C-magnetised Ni-Fe. For C-magnetised Ni and L-magnetised NiFe there is an increase of μ if the field is not too weak. G. E. A.

5297. Magnetic Susceptibility of Binary Alloys of Tl. Audrey W. David and J. F. Spencer. *Faraday Soc., Trans.* 32. *pp.* 1512–1516, *Oct.,* 1936.—The variation in the mass susceptibility with change in composition is measured for a complete series of alloys of Tl with Cd and Bi. Freshly cast and vacuum-annealed specimens are used. The susceptibility composition curve for Tl-Cd alloys shows no irregularities but that for the Tl-Bi alloys clearly shows the presence of inter-metallic compounds containing 36 and 71 % Tl, corresponding to Bi_5Tl_3 and Bi_2Tl_3. H. J. H. S.

5298. Magnetism and Cold-Working in Metals. Part II. Single-Crystals of Bi, Zn and Sn. S. R. Rao. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 186–203, *Aug.,* 1936.—Single crystals of Bi, Zn and Sn were prepared by the method of slow cooling and the influence of cold-working on the principal susceptibilities was investigated. Bi crystals show a decrease in susceptibility, this decrease being of the same order of magnitude as in polycrystals. This is explained by assuming a superstructure of planes after Goetz and Focke. Zn crystals show very small decrease in the diamagnetic susceptibility on cold-working. Sn crystals have their paramagnetic susceptibility slightly lowered by tensional stress. This decrease is much smaller than in polycrystals. This is accounted for as being due to the greater influence of the *boundaries* of the small crystals (inside the polycrystal) than the *interior*. The theory of Honda and Shimizu adequately explains these observed changes of susceptibility. [For Part I see Abstract 4875 (1936).] AUTHOR.

5299. Magnetochemistry of Silver and Copper: Divalent Ions and Mixed Crystals. N. Perakis and L. Capatos. *J. de Physique et le Radium.* 7. *pp.* 391–400, *Sept.,* 1936.—A detailed account of the experiments leading up to the results which have already been published [see Abstract 4375 (1936)]. C. A. S.

5300. Diamagnetic Anisotropy of Aromatic Molecules. L. Pauling. *J. Chem. Phys.* 4. *pp.* 673–677, *Ovt.,* 1936.—Values of the diamagnetic anisotropy of benzene and other aromatic hydrocarbon molecules are calculated on the basis of the assumption that the p_z electrons (one per aromatic C atom) are free to move from C atom to adjacent C atom under the influence of the impressed fields. When combined with the assumed values for the contributions of the other electrons ($-2 \cdot 0 \times 10^{-6}$ for H, $-4 \cdot 5 \times 10^{-6}$ for aromatic C, $-6 \cdot 0 \times 10^{-6}$ for aliphatic C) these lead to principal diamagnetic susceptibilities of molecules in approximate agreement with the available experimental data. The diamagnetic anisotropy of graphite is also discussed. AUTHOR.

5301. Movements of a Deformable Body Associated with General Electromagnetic Fields. G. Arrighi. *Comptes Rendus,* 203. *pp.* 427–429, *Aug.* 18, 1936.—Irrotational motion is shown to correspond to a general electric field, stationary motion to a general magnetic field. Irrotational and stationary motion corresponds to a zero electromagnetic field. W. S. S.

5302. Inductance of Iron-Cored Coils Having an Air-Gap. G. F. Partridge. *Phil. Mag.* 22. *pp.* 665–678, *Oct.,* 1936.—Curves are given showing the variation of inductance of an iron-cored coil with length of air-gap. For relatively large gaps the inductance varies according to the well-known expression $L = 1 \cdot 25\ N^2A \times 10^{-8}/l_a$ henries, but, due to leakage, the measured value of the inductance may be much larger than that given by the above expression. A method of estimating the effect of leakage is given sufficient to enable the inductance to be calculated within a few per cent. A general formula is given for calculating the inductance when the window of the iron stampings is rectangular and the air-gap is cut in the longer side, sufficient to give the inductance within 10 % for all gaps up to a gap ratio of 0·02. The same formula gives the inductance within 2 % when the air gap is introduced into the core of the iron circuit. AUTHOR.

See also Abstracts 4981, 5017, 5242, 5284.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***5303. Apparatus for Electromedicine. H. Nitka.** *V.D.I.* 80. *pp.* 1153–1158, *Sept.* 19, 1936.—A survey of modern electromedical apparatus, including sources of u.v. light, X-rays, h.f. treatment and electrocardiography. In the X-ray section are included new tubes and compact, portable diagnostic apparatus, and also a h.v. generator for 800 kV. The h.f. generators include valve oscillators giving wave-lengths of 3–7 m. G. E. B.

5304. Applications of High Frequency Are without Exception only Types of d'Arsonval Treatment. L. Delherm. *J. de Radiologie et d'Électrologie*, 20. *pp.* 421–426, *Aug.*, 1936.—Since the more extensive recent employment of h.f. currents for medical curative purposes, Schliephake and others of the German school have used the term ultra-short-wave treatment. The first application of short-wave h.f. currents was by d'Arsonval in 1890 and to such form of treatment the term d'Arsonvalisation has been hitherto commonly applied, d'Arsonval having priority in respect to Tesla. A long extract from a paper by Olivier in 1900 showing the priority of d'Arsonval is given, together with an illustration from *Le Matin* in 1913. The present author's contention is that the term d'Arsonvalisation is the more correct term for the medical application of h.f. energy, ultra-short-wave therapy being only a modality of d'Arsonvalisation. B. J. L.

***5305. Kineradiography. R. J. Reynolds.** *I.E.E., J.* 79. *pp.* 389–398; *Disc.*, 399–400, *Oct.*, 1936.—Deals with the author's experiments in respect to X-ray kineradiography employing the indirect method, *i.e.*, the image of the fluorescent screen is photographed, the X-rays not acting directly upon the photographic film [see Abstract 3941 (1934)]. The requirements of this method and the construction of the author's apparatus are dealt with in detail together with the probable wide applications, particularly in respect to heart investigations. Kymographic investigation of the heart is also discussed. B. J. L.

***5306. Tubular Diaphragms. W. Watson.** *Radiography*, 2. *pp.* 147–154, *Oct.*, 1936.—Discusses the design and function of tubular diaphragms to reduce scattered radiation in radiography. It is shown that considerably improved radiographs result from the use of such diaphragms, and the question of optimal dimensions is discussed. In fluoroscopy, it is suggested that similar results may be obtained by using a set of suitable tubular diaphragms, perhaps mounted on a wheel for convenience. A rotating lead star-wheel is suggested for shading, say the foot, to obtain uniform densities. G. E. B.

***5307. Dosimetry in Radiation Therapy. Part I. γ-Ray Measurements in Roentgens. O. Glasser and L. Rovner.** *Am. J. of Roentgenology and Radium Therapy*, 36. *pp.* 94–105, *July*, 1936.—The standard air chamber ionometer has been shown by study during the past few years to be incapable of measuring the true value of free air ionisation produced by very short wave-length radiation. These limitations do not affect the small enclosed type of chamber when measurements are made in a large volume of irradiated air. Study of the best nature of the wall material for the construction of enclosed chambers has been made by many authors, and the results can be unified by the measured values of the Ra constant r/mgeh-cm., *i.e.*, the value of roentgens per mg.-element-hour at 1 cm. distance. This constant serves as a standard upon which to base ionisation measurements for ultra-short radiations. The authors describe in detail further measurements of this constant, in agreement with their earlier measurements and the value for γ-radiations of Ra B and Ra C filtered by 0·5 mm. Pt is 8·8 r/mgeh.-cm. The ionisation chamber used is described in detail in respect to wall construction, and extensive tabular representation of other investigators' values, with their methods of investigation, is given together with an extensive Bibliography. B. J. L.

***5308. Construction of Radium Plaques and a New Calculating Appliance. H. S. Souttar.** *Brit. J. of Radiology*, 9. *pp.* 546–554; *Disc.*, 554–555, *Aug.*, 1936.—Ra plaques are used for treating superficial accessible cancer as of the skin and mouth with consequent advantages of accuracy of dosage and absence of operative interference. In construction of such plaques two questions arise respecting the distribution of the radiation in relation to the situation of the Ra upon the surface of the plaque and a more difficult problem is the calculation of the quantity of Ra required, so distributed to produce a given intensity at a distance from the surface of the plaque. This subject is discussed in respect to a calculating apparatus. Additionally a pneumatic device to permit transference of large quantities of Ra when in medical use, without danger to the operators is described and the isodosis curves relating to such a device are illustrated. In the *Discussion* **W. V. Mayneord** differed in respect to the distribution of radiation intensity as described by the author. B. J. L.

5309. Comparative Effects of X-Rays and Neutrons on Normal and Tumour Tissue. J. H. Lawrence, P. C. Aebersold, and E. O. Lawrence. *Nat. Acad. Sci., Proc.* 22. *pp.* 543–556, *Sept.*, 1936.—In previous work [see Abstract 2419 (1936)] it was shown that, per unit ionisation, neutrons are more effective than X-rays in producing lymphopenia in rats. This is probably due to the high ionisation density produced by neutrons. In the present experiments the relative effects of filtered 200 kV X-rays and neutrons on normal mice and on Sarcoma 180, an easily transplantable tumour of mice, are noted. The tumour tissue was irradiated *in vitro*, and then transplanted into normal susceptible mice. Preliminary results indicate that, per unit ionisation, neutrons are three times as effective in destroying normal mouse tissue, and four times as effective in destroying Sarcoma 180 *in vitro*. J. E. R.

See also Abstracts 5085, 5089, 5090, 5091, 5184.

OSCILLATIONS.

***5310. Self-Synchronising Time-Base for Distant Observation of Wireless Pulse Transmissions. S. H. W. H. Falloon and F. T. Farmer.** *Phys. Soc., Proc.* 48. *pp.* 865–868, *Nov.* 1, 1936.—A circuit is described for producing in a kathode-ray oscillograph a time-base suitable for the investigation of wireless pulses reflected from the ionosphere when no ground wave is present. The time-base is locked to the received groups of echoes and gives a stationary pattern on the oscillograph even when all the echoes are fading considerably. The whole group of echoes including the first, is delineated on a portion of the time-base which is not obscured by end effects in the trace, so that accurate measurements of time-intervals can be made. AUTHORS.

5311. Lower Ionosphere. R. C. Colwell and A. W. Friend. *Phys. Rev.* 50. *pp.* 632–635, *Oct.* 1, 1936.—There are two well-defined regions in the lower part of the ionosphere. One of these (the D-region) extends from 35–65 km., the other (the C-region) lies between 2–30 km. They have been detected by the use of a very short pulse of the order of 3 microseconds and a receiving set with a small time-lag. The ground and reflected pulses are separated by using a rapid sweep on a kathode-ray oscilloscope. Similar results have been obtained by Watson-Watt, Mitra and their co-workers. AUTHORS.

See also Abstracts 5263, 5303, 5318.

PHOTOELECTRICITY.

5312. Analysis of Photoelectric Data. R. J. Cashman and N. C. Jamison. *Phys. Rev.* 50. *pp.* 568–569. *Sept.* 15, 1936.—In connection with Fowler's method of determining photoelectric work functions comparisons are made between different methods of plotting experimental data on Ba. The experimental value $4{\cdot}3 \times 10^{-33}$ cm^2. sec. quantum $^{-1}$ is found for the proportionality factor α in DuBridge's theory, *i.e.*, the probability that an electron at the surface of the metal will absorb a quantum and appear as a photoelectron. Thus on this theory the ratio of experimental to theoretical maximum current is 1 : 325. The experimental value for the corresponding proportionality factor β in Fowler's theory is $5{\cdot}0 \times 10^{-25}$ cm^3. quantum^{-1}, whence the ratio of experimental to theoretical maximum current comes out to 1 : 120. It is suggested that the discrepancy may be due to incomplete light absorption. L. A. W.

5313. Photoelectric Activation of Platinum and Tantalum Surfaces by Hydrogen. K. Reger. *Zeits. f. Physik*, 102. 3–4. *pp.* 156–162, 1936.—Foils of Pt and Ta were heated in a high vacuum in a quartz vessel. The photoelectric saturation current was then measured with the aid of a shunted quadrant electrometer. The light was the unfiltered emission of a quartz-mercury-arc lamp whose intensity was carefully kept constant. The experiment was then repeated after admitting small amounts of H_2 of different origin and purity. It was found that H_2 as taken from a commercial bomb produced a very small increase of the saturation current. Electrolytic H_2, admitted directly, produced a very large increase, but not if it was carefully dried and passed over an alloy of K and Na at 250°. The different behaviour is probably due to the fact that the electrolytic H_2 contains a small percentage of H atoms which are more easily adsorbed, and which are removed by the cleaning process. R. P.

5314. Photo-Sensitisation of Films of Potassium by Means of Hydrogen. R. C. L. Bosworth. *Faraday Soc., Trans.* 32. *pp.* 1369–1375, *Sept.*, 1936.—Monatomic films of K on W are prepared and examined photoelectrically. These films will not react with H_2 at room-temperature or at any temperature below the volatilising point. The films do, however, react with atomic H to form a WHK surface which is capable of absorbing fresh K to give a sensitive WKHK surface. A still more sensitive surface may be prepared by depositing K on a WH surface. A graphical method of obtaining the threshold from two readings of photoemission of different frequencies near the threshold, is derived from Fowler's equation for photoelectric emission. AUTHOR.

5315. Photoelectric Properties of Zinc. C. F. DeVoe. *Phys. Rev.* 50. *pp.* 481–485, *Sept.* 1, 1936.—The work function of a vacuum-distilled surface of zinc was found to be 4·24 volts at $1 \cdot 5 \times 10^{-8}$ mm. pressure ; as the pressure of air was increased the work function decreased to a minimum at about 10^{-6} mm. pressure and then increased. He had no effect to a pressure of 3 mm. N_2 had no effect to a pressure of 10^{-3} mm. AUTHOR.

5316. Standardisation of Photoelectric Cells by Means of Sunlight. A. Ångström. *Gerlands Beitr. z. Geophys.* 48. 2.–3. *pp.* 307–308, 1936. *In English.*—If the radiation from sunlight were always constant for a given height of the sun, it would be simple to use it to standardise photoelectric cells ; however, since the radiation is principally affected in the visible spectrum by turbidity, by taking two or more readings for a given height of the sun, the effect of turbidity can be eliminated and the constant of the instrument obtained. H. M. B.

See also Abstracts 5232, 5282.

PIEZOELECTRICITY.

***5317. Decrement of Damping in Piezoelectric Crystals. H. Gockel.** *Phys. Zeits.* 37. *pp.* 657–659, *Sept.* 15, 1936.—An apparatus is developed to determine the logarithmic damping decrement in piezoelectric crystals by measuring the decay of the amplitude of the vibration after the exciting electric forces have been removed. The influence of the surrounding air, the shape of the electrodes, and the nature of the crystal faces are all taken into account. As is shown by coating the crystal face with collodion, the decrement is influenced very markedly by the nature of the surface. In general the damping is found to be greater in materials in which the velocity of sound is low. Rochelle salt shows anomalous results which are to be related to its well-known hysteresis properties. For technical applications, asparagine would appear to be the most suitable after quartz and tourmaline. G. G.

5318. Precision Measurement of Wave-Length by Quartz. L. Bergmann. *Hochfrequenztechn. u. Elektroakustik*, 48. *pp.* 87–89, *Sept.*, 1936.—A method of wave-length measurement by quartz is described the principle of which is that by a piezoelectric quartz plate excited to harmonic vibrations optically a grating is formed and in the then appearing diffraction phenomenon the distance of the diffraction image of the first order is measured by means of an ocular micrometer. From this distance is obtained directly the ordinal number of the harmonic vibration concerned, and thus, after once adjusting to a standard, the frequency or wave-length of the quartz exciting electric vibration is obtained. J. J. S.

See also Abstracts 4981, 5282.

THERMIONICS.

5319. Emission Images of Thoriated Tungsten and Molybdenum. Part III. E. Brüche and H. Mahl. *Zeits. f. techn. Physik*, 17. 8. *pp.* 262–266, 1936.—A summary is given of the fundamental similarities between the emission behaviour of W and Mo in the thoriated condition. The processes involved in the formation and emission of an active deposit are followed by means of electron optical images, a number of which are given in illustration. [For Part II see Abstract 2458 (1936).] H. J. H. S.

See also Abstracts 5230, 5282.